

**ASSESSMENT OF DELAWARE SOLID WASTE
DISCARDS IN 2000 AND THE POTENTIAL
FOR RECYCLING OF MATERIALS**

Prepared for

**Delaware Solid Waste Authority
Dover, Delaware**

By

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Table of Contents

EXECUTIVE SUMMARY	ES-1
FEATURES OF THIS REPORT.....	ES-1
MUNICIPAL SOLID WASTE IN 2000	ES-1
MSW GENERATION AND RECOVERY	ES-1
MSW DISCARDS	ES-3
RESIDENTIAL AND COMMERCIAL SOURCES OF MSW.....	ES-3
SELECT NON-MUNICIPAL SOLID WASTE IN 2000	ES-7
CHAPTER 1 – SOLID WASTE GENERATION.....	1-1
MUNICIPAL SOLID WASTE	1-2
METHODOLOGY	1-2
GENERATION.....	1-9
SELECTED CONSUMER ELECTRONICS GENERATION	1-12
SELECT NON-MUNICIPAL SOLID WASTE	1-19
METHODOLOGY	1-19
GENERATION.....	1-21
LIMITATION OF GENERATION DATA.....	1-24
CHANGES IN GENERATION RATES.....	1-25
CHANGES IN MSW CATEGORIES.....	1-26
CHANGES IN NON-MSW CATEGORIES.....	1-35
CHAPTER 2 – SOLID WASTE RECOVERY	2-1
MUNICIPAL SOLID WASTE	2-1
DURABLE GOODS	2-2
NONDURABLE GOODS	2-4
CONTAINERS AND PACKAGING.....	2-7
OTHER WASTES	2-9
BEVERAGE CONTAINER REDEMPTION	2-9
SELECT NON-MUNICIPAL SOLID WASTE	2-10
CONSTRUCTION AND DEMOLITION DEBRIS (C&D)	2-10
USED OIL AND OIL FILTERS	2-11
CHANGES IN RECOVERY RATES	2-12
CHAPTER 3 – SOLID WASTE DISCARDS	3-1
MSW DISCARDS.....	3-1
MSW DIVERSION FROM DISPOSAL.....	3-4
C&D DEBRIS DISCARDS.....	3-4
CHAPTER 4 – RESIDENTIAL YARD TRIMMINGS SURVEY	4-1
SURVEY QUESTIONS AND RESPONSES	4-2
REFERENCES.....	R-1

List of Tables

Table ES-1	Delaware Generation of Products in MSW, 2000	ES-2
Table ES-2	Delaware Recovery of Products in MSW, 2000	ES-2
Table ES-3	Delaware Generation and Recovery of Products in MSW, 2000	ES-4
Table ES-4	Delaware MSW Discards, 2000	ES-6
Table ES-5	Delaware Generation, Recovery and Discards of MSW by Source, 2000	ES-6
Table ES-6	Delaware Generation, Recovery and Discards of Select Non-MSW, 2000	ES-7
Table 1	Products Generated in the Municipal Waste Stream	1-10
Table 2	Delaware Residential and Commercial Municipal Waste Stream	1-13
Table 3	Estimated Life of Selected Consumer Electronics	1-16
Table 4	Estimated Potential Generation Selected Consumer Electronics, 2000 to 2005	1-18
Table 5	Economic Indicators Delaware versus U.S.	1-19
Table 6	Delaware Construction & Demolition Debris Estimates	1-21
Table 7	Percent Change Between 1997 and 2000 for Products Generated in the Municipal Waste Stream	1-27
Table 8	Change in Delaware Construction & Demolition Debris Estimates From 1997 to 2000	1-35
Table 9	Products Recovered From the Municipal Waste Stream	2-4
Table 10	Delaware Container Deposits Paid and Redeemed (2000)	2-8
Table 11	Delaware Construction & Demolition Debris Recovery Estimates	2-11
Table 12	Delaware Estimated Used Oil and Oil Filter Recovery (2000)	2-12
Table 13	Comparison of 1997 and 2000 MSW Recovery Rates	2-13
Table 14	Delaware Municipal Solid Waste Discards	3-2
Table 15	Delaware Estimated Yard Trimmings Diversion in 2000	3-5
Table 16	Delaware Residential Yard Trimmings Survey, 2002	4-1

List of Figures

Figure 1	Leaf Management Options	4-3
Figure 2	Grass Management Options	4-4
Figure 3	Brush Management Options	4-4

ASSESSMENT OF DELAWARE SOLID WASTE DISCARDS IN 2000 AND THE POTENTIAL FOR RECYCLING OF MATERIALS

EXECUTIVE SUMMARY

FEATURES OF THIS REPORT

This report describes Delaware's municipal solid waste (MSW) stream for 2000. This is an update of a report completed for data year 1997.¹ In addition the following non-MSW waste streams are included: construction and demolition debris and used oil and oil filters. Also discussed are the changes in generation (on a per capita basis) and recovery (on a percentage basis) from 1997 to 2000. This report includes information on:

- statewide MSW generation, recovery, and discards for 2000
- products (e.g., containers, packaging) found in the waste stream
- statewide construction and demolition debris and used oil and oil filter generation, recovery, and discards for 2000
- per capita generation and discard rates
- residential and commercial generation, recovery and discards of MSW
- comparison of 1997 and 2000 generation and recovery.

Total recovery in Delaware is presented two different ways in this report. The first estimate is based on the U.S. Environmental Protection Agency (EPA) definition of recovery through recycling and composting. The second estimate is based on Delaware's definition of recycling and resource recovery (including energy recovery).

MUNICIPAL SOLID WASTE IN 2000

MSW GENERATION AND RECOVERY

MSW consists of products grouped into four main categories: (1) durable goods (e.g., appliances), (2) nondurable goods (e.g., newspapers), (3) containers and packaging and (4) other wastes. Tables ES-1 and ES-2 show generation and recovery of MSW in Delaware in 2000 by category. Methodology is discussed in Chapters one through three. Other wastes (mainly yard trimmings) comprised the largest portion of products generated, at 37 percent (303,600 tons) of total MSW generation. Containers and packaging made up the second largest fraction, comprising about 27 percent (224,200 tons). The third largest category of products was nondurable goods, which comprised 22 percent (177,800 tons) of total MSW generation. The fourth category, durable goods, accounted for the remaining 14 percent (117,300 tons) of total MSW generation.

¹ Assessment of Solid Waste Discards in Delaware and the Potential for Recycling of Materials. Franklin Associates, Ltd. April, 1999.

Table ES-1
DELAWARE GENERATION OF PRODUCTS IN MSW, 2000

	Generation (tons)	Percent of Total
Products		
Durable Goods		
Durable Goods	117,300	14%
Nondurable Goods	177,800	22%
Containers & Pkg	224,200	27%
Other Wastes	<u>303,600</u>	<u>37%</u>
<i>Total MSW Generation</i>	822,900	100%

See Table ES-3 for detail.

Source: Franklin Associates, Ltd.

The first recovery estimate in Table ES-2 (175,990 tons) is calculated using the US EPA definition of recycling and composting. Energy recovery is not included in this definition. Also the US EPA defines recovery of major appliances to include only the steel that is recovered. Composting of yard trimmings (grass, leaves and brush) does not include yard trimmings that are landspread without composting or stumps from land clearing or storm debris that may be chipped for mulch. Stumps and storm debris are considered non-MSW components by the US EPA.

Table ES-2
DELAWARE RECOVERY OF PRODUCTS IN MSW, 2000

	tons	Percent of Total Generation
Generation	822,900	
Recovery		
1. EPA Methodology	175,990	21%
2. Including energy recovery of tires and total appliances	185,280	23%

See Table ES-3 for detail.

Source: Franklin Associates, Ltd.

The second estimate (185,280 tons) includes tires recovered for energy and major appliances collected for recycling outside the state of Delaware. Major appliances collected for recovery are processed out-of-state; therefore any residues from the recycling process are diverted from Delaware landfills.

Table ES-3 shows a more detailed breakdown, by weight, of MSW products generated and recovered in Delaware in 2000. Recovery of each product is shown as a percentage of generation of the individual product. High recovery rates were estimated for major appliances (84 percent), tires (68 percent) and lead acid batteries (96 percent). Nondurable goods with estimated high recovery rates include newspapers (48 percent) and office papers (41 percent). Beer and/or soft drink containers (glass, aluminum, and plastic) were recovered at 52 percent, 56 percent, and 24 percent respectively. Milk containers were recovered at 31 percent in 2000. Corrugated boxes were estimated at a 68 percent recovery rate. In the category other wastes, yard trimmings were estimated to be composted at 17 percent.

Total recovery of MSW in Delaware was estimated at 21 percent according to the US EPA definition of recycling and composting. This compares to 28 percent on a national level. When energy recovery of tires and major appliance diversion is included in the MSW recovery rate, Delaware is recovering 23 percent of MSW generation.

MSW DISCARDS

Table ES-4 shows Delaware MSW discards by category. The other wastes category comprised the largest portion of products discarded at 42 percent of total discards. Containers and packaging was the second largest fraction, comprising an estimated 22 percent. The third largest category of products discarded was nondurable goods at approximately 21 percent. The fourth category, durable goods, accounted for the remaining 14 percent of total discards in Delaware.

RESIDENTIAL AND COMMERCIAL SOURCES OF MSW

Sources of MSW, as characterized in this report, include both residential and commercial locations. Delaware residential MSW generation (including MSW from multi-family dwellings) is estimated to be approximately 62 percent of total generation. Commercial MSW generation (including MSW from institutions and businesses) constitutes approximately 38 percent. Depending on the definition used, residential MSW recovery is estimated to be between 35 and 37 percent of total MSW recovered. Table ES-5 shows that the residential portion of the estimated recovery using the US EPA definition of recycling and composting is approximately 37 percent (commercial recovery accounted for 63 percent of the total recovery). The other estimate based on Delaware's definitions show that residential recovery of MSW is 35 percent of total recovery if tires combusted for energy recovery is included (commercial recovery accounted for 65 percent of the total recovery).

Table ES-3
DELAWARE GENERATION AND RECOVERY OF PRODUCTS IN MSW, 2000

	Generation (1) (tons/year)	Recovery (2) (tons/year)	Recovery as a Percent of Generation
Products			
Durable Goods			
Major Appliances	11,500	9,660 (4)	84%
Small Appliances	2,700	0	0%
Furniture and Furnishings	25,000	0	0%
Carpets and Rugs	7,100	60	1%
Rubber Tires	14,000	9,500 (4)	68%
Batteries, lead acid	5,900	5,640	96%
Miscellaneous Durables			
Selected Consumer Electronics	5,100	20	<1%
Other Miscellaneous Durables	46,000	0	0%
<i>Total Miscellaneous Durables</i>	51,100	20	<1%
Total Durable Goods	117,300	24,880	21%
Nondurable Goods			
Newspapers	33,100	15,890	48%
Books	3,200	550	17%
Magazines	7,400	2,720	37%
Office Papers	25,400	10,290	41%
Telephone Directories	2,100	690	33%
Third Class Mail	15,300	3,920	26%
Other Commercial Printing	18,000	3,520	20%
Tissue Paper and Towels	9,300	0	0%
Paper Plates and Cups	2,700	0	0%
Plastic Plates and Cups	2,600	0	0%
Trash Bags	2,700	0	0%
Disposable Diapers	9,000	0	0%
Other Nonpackaging Paper	13,300	0	0%
Clothing and Footwear	20,800	2,870	14%
Towels, Sheets and Pillowcases	2,200	390	18%
Other Miscellaneous Nondurables	10,700	0	0%
Total Nondurable Goods	177,800	40,840	23%
Containers and Packaging			
Glass Packaging			
Beer and Soft Drink Bottles	10,300	5,340	52%
Wine and Liquor Bottles	5,200	1,050	20%
Food and Other Bottles & Jars	10,800	1,460	14%
Total Glass Packaging	26,300	7,850	30%
Steel Packaging			
Beer and Soft Drink Cans	Neg.	0	0%
Food and Other Cans	7,600	820	11%
Other Steel Packaging	700	500	71%
Total Steel Packaging	8,300	1,320	16%

Table ES-3 continued
DELAWARE GENERATION AND RECOVERY OF PRODUCTS IN MSW, 2000

	Generation (1) (tons/year)	Recovery (2) (tons/year)	Recovery as a Percent of Generation
Aluminum Packaging			
Beer and Soft Drink Cans	4,400	2,450	56%
Other Cans	100	0	0%
Foil and Closures	1,100	90	8%
Total Aluminum Packaging	5,600	2,540	45%
Paper & Paperboard Pkg			
Corrugated Boxes	98,000	66,580	68%
Beverage Cartons	2,100	0	0%
Folding Cartons	15,600	0	0%
Other Paperboard Packaging	700	0	0%
Bags and Sacks	4,700	0	0%
Other Paper Packaging	4,900	0	0%
Total Paper & Board Pkg	126,000	66,580	53%
Plastics Packaging			
Soft Drink Bottles	2,300	550	24%
Natural HDPE Bottles	1,900	590	31%
Other Containers	7,600	290	4%
Bags and Sacks	4,900	0	0%
Wraps	7,300	370	5%
Other Plastics Packaging	7,700	200	3%
Total Plastics Packaging	31,700	2,000	6%
Wood Packaging			
Other Misc. Packaging	700	0	0%
Total Containers & Pkg	224,200	81,930	37%
Total Product Wastes	519,300	147,650	28%
Other Wastes			
Food Wastes	78,800	0	0%
Yard Trimmings	215,100	37,630	17%
Miscellaneous Inorganic Wastes	9,700	0	0%
Total Other Wastes	303,600	37,630	12%
Total MSW	822,900	175,990 (3)	21%
Total MSW	822,900	185,280 (4)	23%

(1) Table 1.

(2) Table 9.

(3) EPA estimated recovery methodology. Total MSW Recovered excluding tires collected for energy recovery and the non-steel portion of recovered appliances.

(4) Total MSW Recovered including tires collected for energy recovery and the non-steel portion of recovered appliances.

Source: Franklin Associates, Ltd.

Table ES-4
DELAWARE MSW DISCARDS, 2000

	Discards (1) (tons)	Percent of Total
Products		
Durable Goods	92,420	14%
Nondurable Goods	136,960	21%
Containers & Pkg	142,270	22%
Other Wastes	<u>265,970</u>	<u>42%</u>
<i>Total MSW Discarded (2)</i>	646,910	
<i>Total MSW Discarded (3)</i>	637,620	100%

(1) Table 14.

(2) MSW discards including tires combusted for energy recovery.

(3) MSW discards minus tires combusted for energy recovery.

Source: Franklin Associates, Ltd.

While residential MSW generation is an estimated 62 percent of total MSW generation, residential MSW discards represent 69 to 70 percent of total discards. This is due to a higher recovery rate in the commercial sector.

Table ES-5
DELAWARE GENERATION, RECOVERY AND DISCARDS OF MSW BY SOURCE, 2000
(In tons and percent of total)

	Residential		Commercial		Total
	(tons)	(percent)	(tons)	(percent)	(tons)
Recovery Using US EPA Definitions					
Generation (1)	510,310	62%	312,590	38%	822,900
Recovery (2)(3)	<u>64,670</u>	37%	<u>111,320</u>	63%	<u>175,990</u>
Discards (4)	445,640	69%	201,270	31%	646,910
Recovery Using Delaware Definitions					
Generation (1)	510,310	62%	312,590	38%	822,900
Recovery (2)(5)	<u>65,710</u>	35%	<u>119,570</u>	65%	<u>185,280</u>
Discards (4)	444,600	70%	193,020	30%	637,620

(1) Table 2.

(2) Table 9.

(3) EPA estimated recovery methodology. Total MSW Recovered excluding tires collected for energy recovery and the non-steel portion of recovered appliances.

(4) Generation minus recovery.

(5) Total MSW Recovered including tires collected for energy recovery and the non-steel portion of recovered appliances. Not available on the national level.

Source: Franklin Associates, Ltd.

SELECT NON-MUNICIPAL SOLID WASTE IN 2000

Construction and demolition debris (C&D) generation, recovery, and discards are estimated in this study. These estimates are shown in Table ES-6 along with estimates of used oil and used oil filter generation, recovery, and discards. C&D is estimated to have a recovery rate of 57 percent in Delaware. Used oil and used oil filter recovery is estimated at 82 percent and 66 percent respectively. In this study, used oil burned for energy is considered recovered.

Table ES-6
DELAWARE GENERATION, RECOVERY AND DISCARDS
OF SELECT NON-MSW, 2000

	Generation (tons/year)	Recovery (tons/year)	Discards (tons/year)
Product			
Construction and Demolition Debris	832,200 (1)	475,100 (1)	357,100 (2)
Recovery as a percentage of generation		57%	
Used Oil	5,930 (3)	4,880 (3)	10,810
Recovery as a percentage of generation		82%	
Used Oil Filters	700 (3)	460 (3)	1,160
Recovery as a percentage of generation		66%	

(1) Table 11.

(2) Generation minus recovery.

(3) Table 12.

Source: Franklin Associates, Ltd.

CHAPTER 1

SOLID WASTE GENERATION

This chapter presents estimated municipal solid waste (MSW), construction and demolition debris (C&D), and used automotive oil generation in Delaware for 2000. MSW, as defined by this study, includes post-consumer durable goods (excluding vehicles and other moving equipment), nondurable goods, containers and packaging, food scraps, yard trimmings, and miscellaneous inorganic wastes from residential (single- and multi-family households) and non-residential (commercial, institutional and industrial) sources.

MSW does not include construction and demolition debris, vehicle bodies, municipal sludges, combustion ash, industrial process wastes, and trees and brush from parks, streets or power line trimmings that might also be disposed in municipal waste landfills. Definition of MSW is critical to determining the MSW recycling rate. An inaccurate recycling rate would result if the numerator, which represents recovery, included materials that were not included in the denominator, and vice versa (i.e., non-MSW components).

The sections below contain descriptions of the methodologies used to estimate Delaware-generated MSW along with the estimates developed. Construction and demolition debris and used oil are not components of MSW and are therefore considered separately.

Estimates of MSW were based largely on the use of production data (by weight) for the materials and products that are ultimately discarded as wastes. Information on the geographic flow of these materials and products was used along with economic and demographic data to estimate quantities of various MSW components in Delaware. The MSW definition used in this report is consistent with that used in the annual Environmental Protection Agency MSW characterization reports².

This MSW measurement approach assumes that products are purchased, used and then become part of the solid waste stream. Generation refers to these products before recovery or disposal. Products are assumed as generated solid wastes at the end of their useful life. The measure of useful life varies among materials and products. Packaging materials are assumed as wastes in the same year as produced whereas appliances are assigned various years of life depending on industry and government information from 1971 to 1997 for each type of appliance.

² Municipal Solid Waste In The United States: 1999 Facts and Figures. July 2001. EPA530-R-01-014. And previous editions.

Where Delaware-specific production data were not available, national production data were adjusted by economic or demographic indicators specific to Delaware. For example, the quantity of disposable diapers sold in the U.S. is known but is not available for individual states. To estimate the portion of disposable diapers generated by Delaware, Census Bureau statistics available for both the U.S. and Delaware were used. These statistics included the number of live births in 1998 and 1999. Since it was assumed that Delaware's per child usage of disposable diapers was typical of the U.S., the percentage was applied to national generation of disposable diapers to estimate Delaware's generation.

For products where neither Delaware-specific production data nor economic or demographic indicators were available, national per capita rates were assumed and applied to the 2000 Delaware population of 783,600.

MUNICIPAL SOLID WASTE

METHODOLOGY

Durable Goods

In the report, *Municipal Solid Waste In The United States: 1999 Facts and Figures*, durable goods generally are defined as products having a lifetime of three years or more, although there are some exceptions. In this report, durable goods include large and small appliances, furniture and furnishings, carpets and rugs, rubber tires, lead-acid automotive batteries, and miscellaneous durables. These products are often called "oversize" and/or "bulky" wastes in municipal solid waste management practice and they are generally handled in a somewhat different manner than other components of MSW.

Major Appliances. Major appliances in MSW include refrigerators, washing machines, water heaters, etc. They are often called "white goods". The national database used to determine major appliance generation in Delaware includes industry data from 1971 to 1997. The data details the composition, quantity, and life of individual appliance types.

The statistics on the life of individual appliance types were used to proportion national generation of major appliances to Delaware. The economic factor used to estimate Delaware's portion was industry data on appliance sales. The weighted average age of major appliances taken out of service was estimated at 12 to 13 years. In other words, appliance generation in 2000 reflects the products purchased more than 12 years ago. As such, data on sales (in dollars) of major appliances in 1982 through 1991 was used to estimate this component of Delaware's waste stream. The dollar sales of major appliances in Delaware from 1982 to 1991 were ratioed with corresponding national sales in the same years. The average over this time period was applied to national generation in 2000.

DEFINITIONS

Municipal solid waste (MSW) includes durable goods (excluding vehicles and other moving equipment), nondurable goods, containers and packaging, food scraps, yard trimmings and miscellaneous inorganic wastes from **residential** (single- and multi-family households) and **non-residential** (commercial, institutional and industrial) sources. MSW does not include construction and demolition debris, vehicle bodies, municipal sludges, combustion ash, industrial process wastes, and trees and brush from parks, streets or power line trimmings that might also be disposed in MSW landfills.

Construction and demolition debris (C&D) is waste generated when structures are built, renovated, or demolished. Structures include all residential and nonresidential buildings, and public works projects, such as streets and highways, bridges, and piers.

Source reduction activities reduce the amount or toxicity of wastes that enter the municipal solid waste management system. Reuse of products such as refillable glass bottles, reusable plastic food storage containers, or refurbished wood pallets are examples of source reduction. Management of yard trimmings at home is another example that has a substantial effect on reducing the amount of waste generated.

Generation refers to the amount of materials and products that enter the waste stream before recycling (including composting), landfilling or combustion takes place.

Recovery of materials, as referred to in this report, means removing certain materials/products from the waste stream for the purpose of **recycling** (including composting). According to Delaware Solid Waste Legislation §6402. Definitions, resources recovery also includes energy recovery.

Recycling includes any of the activities necessary for a recovered material to be used in a new product. Recycling involves any and all of the following steps: separating, collection, processing, market or free distribution, remanufacturing (if done), and purchase/use by a consumer.

Preconsumer wastes are waste materials generated prior to use by a consumer. Examples include trimmings, cutting, or shavings generated in an industrial manufacturing, fabrication, or converting process.

Diversion of materials from *landfill* disposal may be accomplished through source reduction, recycling (including composting), and energy recovery.

Discards include the solid wastes remaining after recycling, composting, and energy recovery. In Delaware these discards are disposed of in landfills, although some solid waste is littered, stored, or disposed on site, particularly in rural areas.

Furniture and Furnishings. The approach to estimate furniture and furnishings for Delaware was the same as for major appliances. Sales data for 1982 through 1991 were used to estimate Delaware's generation of furniture and furnishings in 2000 from the national estimate.

Small Appliances and Carpets and Rugs. Delaware generation of small appliances and carpets and rugs was based on national per capita generation rates for each of these applied to Delaware population estimates. It was assumed that the per capita generation rate in 1999 remained constant for 2000 and was multiplied by Delaware's 2000 population.

Rubber Tires. To proportion Delaware's generation of vehicle tires from the national generation of tires, data published by Ward's Communications and the U.S. Department of Transportation were used. The number of vehicle miles traveled in Delaware was expressed as a percentage of vehicle miles of travel for the total U.S. The calculations included data from the years 1999 and 2000.

Lead-acid Batteries. The generation of lead-acid batteries in Delaware was based on motor vehicle registration. The U.S. Department of Commerce data on motor vehicle registration in Delaware and the U.S. were used to proportion from national generation of lead-acid batteries. The most recent commerce data for vehicle registrations is from 1998. The 2000 per capita rate of generation was assumed to be the same as the 1998 rate (the latest year that data were available).

Miscellaneous Durables. Consumer electronics such as television sets, personal computers, stereo equipment, etc. were estimated for Delaware based upon national 1999 per capita estimates. The 2000 per capita rate was assumed to equal the 1999 per capita rate. Other miscellaneous durables were determined by using sales data to allocate quantities to Delaware from the national estimates. Sales data from 1994 through 1997 were used for estimating this component, which assumes a 3 to 7-year life for miscellaneous durables. Miscellaneous durable goods include luggage, sporting equipment, etc.

Nondurable Goods

Old Newspapers (ONP). Old newspapers, as defined here, include all newsprint distributed with daily and weekly newspapers, newsprint type inserts, inserts printed on papers other than newsprint (i.e., groundwood, supercalendered and glossy or coated stock), suburban newspapers, shoppers, free distributions, etc. ONP generation in Delaware was based on published data on the circulation and weights of daily newspapers produced in Delaware as well as those entering Delaware from out-of-state. Smaller weekly newspapers circulation was also included in the total ONP estimate for the state. The estimate excludes pressroom scrap, since it is considered a preconsumer waste and not part of MSW.

Old Magazines. Data on Delaware's circulation of the top 25 magazines in the U.S. were used in estimating this category. Delaware circulation, as a percentage of national circulation of the same 25 magazines, was multiplied by the national quantity of total magazines by weight.

Office Papers. Generation of office papers is estimated for the U.S. EPA reports on MSW generation. (These are the "high grade" papers such as copy paper and computer printout.) To estimate generation of office papers in Delaware, we used a methodology that Franklin Associates has developed for use in estimating quantities of office papers available for recycling. We have used this methodology in studies for local governments and for paper mills.

First, employment in industries known to generate large quantities of office papers was tabulated for Delaware. This includes businesses such as banks, insurance companies, government offices, doctors offices, and other general offices. The total for U.S. office workers in these businesses was also tabulated. Then, office employment in Delaware was taken as a percentage of total U.S. office employment. The state's population was also taken as a percentage of the total U.S. population. The percentage of office workers in Delaware was higher than Delaware's percentage of total U.S. population. Using this data, we scaled Delaware's per capita generation of office papers based on the 2000 national average per capita generation.

Disposable Diapers. The estimated generation of disposable diapers in Delaware was based on the number of births in Delaware in 1998 and 1999 as a percentage of the same statistics for the U.S. This factor, as determined from the statistics, was used to estimate the generation of disposable diapers in Delaware as a percentage of the U.S. generation.

Clothing and Footwear. The clothing and footwear category was determined by using sales data to allocate quantities to Delaware from the national estimates. Apparel and accessory store sales data from 1997 and 1998, the most recent data available, were used for estimating this component.

Other Nondurable Goods. Other nondurable goods include books, directories, third class mail, commercial printing, tissue paper and paper towels, paper and plastic plates and cups, trash bags, other nonpackaging paper, towels, sheets and pillowcases and other miscellaneous nondurables. Typical products in miscellaneous nondurables include shower curtains and other household items, disposable medical supplies, novelty items, and the like. Delaware generation of the nondurable goods listed above was based on national per capita generation rates for each of these applied to Delaware population estimates.

Containers and Packaging

Glass Packaging. Glass beer and soft drink containers generation was determined by using consumption and packaging data provided by industry sources, including the Beverage World annual beverage market index and statistics from the Beer Institute. Wine and liquor bottle generation was based on Delaware wine and liquor consumption (in gallons) versus U.S. consumption times the U.S. generation of wine and liquor bottles (in tons). Other glass container generation was based on national generation rates. Other glass containers are primarily food containers. It was assumed that Delaware food consumption patterns mirrored that of the U.S.

In the case of glass container generation for beer and soft drinks, Delaware's generation was found to be significantly lower than the national average. The composition for beer packaging for Delaware includes 20% glass one-way and 5% glass refillable containers. The composition for beer packaging for the U.S. includes 38% and 2% for glass one-way and glass refillable, respectively. The unusually low percentage of one-way bottles for Delaware translates to a glass bottle generation that is significantly lower than the national average.

Metal Packaging. The generation of metal containers is a function of beverage, food, and other product consumption and the mix of container types used. Metal containers are used for beer, soft drink, food, chemicals, and other products.

Data on soft drink consumption is available by regions of the U.S. and beer consumption is available for each state. Specifically, soft drink consumption data for Delaware was determined from data for the Northeast U.S., while beer consumption data was available specifically for Delaware. The mix of containers used for beer is also available on a state-by-state basis, whereas only national data is available for determining the mix of containers used for soft drinks. This information was used to estimate aluminum and steel beverage cans in Delaware.

Other metal cans—mostly steel food cans, but also paint and household chemical cans—were estimated from national per capita values.

Paper and Paperboard Packaging.

Old Corrugated Containers (OCC). A high percentage of corrugated boxes are used to ship goods from a factory or warehouse to another location where they are unpacked and discarded or recycled. Examples include boxes of canned fruit shipped from the canner to a warehouse, then on to a grocery store; auto parts shipped from a supplier to an auto assembly plant; or containers of motor oil shipped to a warehouse, then to a service station. To estimate quantities of corrugated boxes unpacked (generated) in Delaware, we used a methodology developed by Franklin Associates and often used in projects for both local governments and paper mills.

Generation of OCC was based on the application of corrugated container consumption data by different economic sectors—as provided by the Fibre Box Association³. Statewide employment data for Delaware (from County Business Patterns) were used in conjunction with rates of OCC generation by economic sector to estimate statewide OCC⁴.

Beverage Cartons. Regional milk consumption and packaging data, which are published by the USDA, were used to determine Delaware's generation of milk cartons. The U.S. beverage carton generation includes juice bottles, as well as milk cartons. Since there is insufficient regional data on juice consumption, Delaware's generation of milk cartons compared to the U.S. generation of milk cartons was used as a factor to determine Delaware's portion of the U.S. beverage carton generation. The most recent data for this category is from 1999. The 2000 generation rates were estimated by increasing the 1999 data by the same rate as the national and state population growth between 1999 and 2000 (this calculation assumed that the per capita generation rates were the same for 1999 and 2000).

Other Paper Packaging. Other paper packaging includes folding cartons, bags and sacks, and other paper and paperboard packaging. Delaware's per capita rate of generation of other paper packaging was assumed to equal the U.S. per capita rate of generation.

Plastics Packaging.

Soft Drink and Milk Containers. Plastic soft drink containers were determined by the same methodology as described above for soft drink cans. Regional milk consumption and packaging data were used to determine Delaware's generation of HDPE milk bottles. The U.S. HDPE beverage container generation includes water and juice bottles, as well as milk containers. Since there is not sufficient regional data on water and juice consumption, Delaware's generation of HDPE milk bottles compared to the U.S. generation of HDPE milk bottles was used as a factor to determine Delaware's portion of the U.S. HDPE beverage container generation.

Other Plastic Containers. Generation of other plastic containers was based on the assumption that Delaware consumption patterns are similar to the national average. Published data on patterns of consumption were used and allocated to Delaware based on population.

Wood Packaging. Generation of wood pallets in the U.S. is also estimated in the MSW characterization reports for EPA. The primary use for these pallets is shipping goods, usually goods that are packaged in corrugated boxes. We therefore used our calculation of corrugated boxes to estimate generation of wood pallets in Delaware. This was done by applying the ratio of generation of corrugated boxes in Delaware to the U.S. generation of corrugated boxes multiplied by the U.S. generation of pallets.

³ Fibre Box Association. 2001.

⁴ Franklin Associates, Ltd.

Other Miscellaneous Packaging. National per capita generation rates were used to estimate Delaware's generation of other packaging. Other miscellaneous packaging includes packaging such as bags made of textiles, small amounts of leather, and the like.

Other Wastes

Food Waste. Food waste in MSW includes that from households, commercial establishments, institutional establishments such as schools and hospitals, and industrial sources such as factory lunchrooms. Retail sales from grocery stores, and eating and drinking places in the U.S. and Delaware were reviewed, as well as, the cost of living index for grocery items in Delaware.

In 2000, Delaware accounted for 0.33 percent of U.S. retail sales in grocery stores and eating and drinking places (U.S. Department of Commerce, 2000). However, Delaware's population in 2000 was only 0.28 percent of the U.S. population. This would suggest that Delaware would have a higher than average food waste generation. The ratio of Delaware's retail food sales to population is 17 percent higher than that of the U.S.

Delaware's relatively high cost of living explains why retail food sales in Delaware (on a per capita basis) are higher than U.S. retail food sales. The cost of living index in Delaware's major population centers is 8 percent higher than that for the U.S. The difference between the two relevant indices (the composite cost of living index and the cost of groceries index) ($17\% - 8\% = 9\%$) was used to adjust the national average in order to estimate Delaware's per capita generation of food waste.

Yard Trimmings. Yard trimmings include grass, leaves, and tree and brush trimmings from residential, institutional, and commercial sources. The U.S. EPA considers yard trimmings that are managed on-site by the homeowner as being source reduction and therefore not generated⁵. The generation methodology used in the study is consistent with that definition.

A combination of data sources was used to estimate Delaware's generation of yard trimmings. Delaware specific quantity data were obtained from municipalities in Delaware that have curbside collection of leaves. Additionally, DSWA provided in-house weight and area data from grass clippings that were collected, over a growing season, by a staff member. The field data were combined with three other sources of information (1) surveys sent to Delaware residents (2) Kent county residential lot size information based on geographic information systems (GIS) data and (3) Delaware census data on housing and population. After estimates were developed for leaves and grass, tree and brush trimmings were assumed at 10 percent by weight of total yard trimmings.

⁵ In this report, source reduction of yard trimmings is estimated separately. See Chapter 3 "Diversion from disposal"

Miscellaneous Inorganic Wastes. Miscellaneous inorganic wastes were estimated for Delaware based upon national per capita estimates for 1999. The 2000 per capita rate was assumed to equal the 1999 per capita rate. This relatively small category of MSW is not well defined and often shows up in sampling reports as “fines” or “other.” It includes soil, bits of concrete, stones, and the like.

GENERATION

Total MSW Generation

Total generation of MSW from the state of Delaware was estimated at 822,900 tons for 2000. Generation estimates are provided for 50 component categories of MSW in Table 1. Table 1 also shows the tons generated per year for each component, the pounds per person per year, and the percent of total generation for each component. The appendix tables referenced are the worksheets used to determine Delaware generation. Where national averages were used to determine Delaware’s generation, the U.S. per capita was multiplied by Delaware’s population of 783,600. The component categories where Delaware specific information was utilized represent approximately 78 percent of total MSW generation by weight.

Durable Goods. Delaware’s durable goods generation including such items as appliances, furniture, carpets and rugs, and tires, is estimated at 14.3 percent of total MSW generation. The pounds per person of durable goods generated is 15 percent higher than the national average.

Nondurable Goods. Total nondurable goods generation equals 21.6 percent of the total generation in Delaware. Paper nondurable goods (newspapers, books, magazines, etc.) equal 15.8 percent of total generation. Newspaper generation is below the national average, while magazines and office paper generation are above the national average. Clothing and footwear are also above the national average.

Containers and Packaging. Containers and packaging comprise 27.2 percent of the total generation. Regional market data shows that in 2000 Delaware consumed 11 percent less packaged soft drinks than the U.S. average consumption. Packaged liquor and packaged wine consumption was above U.S. average by 6 and 24 percent respectively.

Another difference observed from market data is that a higher percentage of beer is packaged in aluminum cans and a lower percentage in glass bottles in Delaware than the U.S. average. This may be the result of the deposit container law, although this appears not to be true for soft drink packaging.

Table 1
PRODUCTS GENERATED IN THE MUNICIPAL WASTE STREAM

Products	U.S. 1999 (1)	Delaware, 2000		%	Appendix Table Reference
	(lb/person/yr)	(tons/yr)	(lb/person/yr)		
Products					
Durable Goods					
Major Appliances	27	11,500 *	29	1.4	A-1
Small Appliances	7	2,700	7	0.3	
Furniture and Furnishings	57	25,000 *	64	3.0	A-2
Carpets and Rugs	18	7,100	18	0.9	
Rubber Tires	34	14,000 *	36	1.7	A-3
Batteries, lead acid	14	5,900 *	15	0.7	A-4
Miscellaneous Durables					
Selected Consumer Electronics	13	5,100	13	0.6	
Other Miscellaneous Durables	90	46,000 *	117	5.6	A-5
<i>Total Miscellaneous Durables</i>	103	51,100	130	6.2	
Total Durable Goods	259	117,300	299	14.3	
Nondurable Goods					
Newspapers	109	33,100 *	84	4.0	A-6, A-7
Books	8	3,200	8	0.4	
Magazines	16	7,400 *	19	0.9	A-8
Office Papers	57	25,400 *	65	3.1	A-9
Telephone Directories	5	2,100	5	0.3	
Third Class Mail	39	15,300	39	1.9	
Other Commercial Printing	46	18,000	46	2.2	
Tissue Paper and Towels	24	9,300	24	1.1	
Paper Plates and Cups	7	2,700	7	0.3	
Plastic Plates and Cups	7	2,600	7	0.3	
Trash Bags	7	2,700	7	0.3	
Disposable Diapers	24	9,000 *	23	1.1	A-10
Other Nonpackaging Paper	34	13,300	34	1.6	
Clothing and Footwear	46	20,800 *	53	2.5	A-11
Towels, Sheets and Pillowcases	6	2,200	6	0.3	
Other Miscellaneous Nondurables	27	10,700	27	1.3	
Total Nondurable Goods	462	177,800	454	21.6	
Containers and Packaging					
Glass Packaging					
Beer and Soft Drink Bottles	41	10,300 *	26	1.3	A-12, A-15
Wine and Liquor Bottles	15	5,200 *	13	0.6	A-13, A-14
Food and Other Bottles & Jars	28	10,800	28	1.3	
Total Glass Packaging	84	26,300	67	3.2	
Steel Packaging					
Beer and Soft Drink Cans	Neg.	Neg.	Neg.	Neg.	
Food and Other Cans	20	7,600	19	0.9	
Other Steel Packaging	2	700	2	0.1	
Total Steel Packaging	22	8,300	21	1.0	

Table 1 continued
PRODUCTS GENERATED IN THE MUNICIPAL WASTE STREAM

	U.S. 1999 (1)	Delaware, 2000			Appendix Table Reference
	(lb/person/yr)	(tons/yr)	(lb/person/yr)	%	
Aluminum Packaging					
Beer and Soft Drink Cans	11	4,400 *	11	0.5	A-12, A-15
Other Cans	0.4	100	0.4	0.0	
Foil and Closures	3	1,100	3	0.1	
Total Aluminum Packaging	14	5,600	14	0.7	
Paper & Paperboard Pkg					
Corrugated Boxes	223	98,000 *	250	11.9	A-16
Beverage Cartons	3	2,100 *	5	0.3	A-17, A-18
Folding Cartons	40	15,600	40	1.9	
Other Paperboard Packaging	2	700	2	0.1	
Bags and Sacks	12	4,700	12	0.6	
Other Paper Packaging	12	4,900	13	0.6	
Total Paper & Board Pkg	292	126,000	322	15.3	
Plastics Packaging					
Soft Drink Bottles	6	2,300 *	6	0.3	A-15
Natural HDPE Bottles	5	1,900 *	5	0.2	A-18
Other Containers	19	7,600	19	0.9	
Bags and Sacks	12	4,900	13	0.6	
Wraps	19	7,300	19	0.9	
Other Plastics Packaging	20	7,700	20	0.9	
Total Plastics Packaging	81	31,700	81	3.9	
Wood Packaging	56	25,600 *	65	3.1	A-19
Other Misc. Packaging	2	700	2	0.1	
Total Containers & Pkg	551	224,200	572	27.2	
Total Product Wastes	1,273	519,300	1,326	63.1	
Other Wastes					
Food Wastes	185	78,800 *	201	9.6	
Yard Trimmings	203	215,100 *	549	26.1	
Miscellaneous Inorganic Wastes	25	9,700	25	1.2	
Total Other Wastes	413	303,600	775	36.9	
Total MSW Generated - Weight	1,685	822,900	2,100	100	

(1) *Municipal Solid Waste In The United States: 1999 Facts and Figures.*

* Product generation based on Delaware specific information. Generation of other products based on national per capita rates. Generation is before materials recovery or combustion.

MSW does not include construction and demolition debris, industrial process wastes, or certain other wastes.

Details may not add to totals due to rounding.

Neg. = negligible

Delaware Population 2000

783,600

U.S. Population 2000

281,421,906

Source: Franklin Associates, Ltd.

Other Wastes. The other wastes category, including food wastes, yard trimmings, and miscellaneous inorganic wastes, is estimated at 36.9 percent. The yard trimmings category is higher than the estimated national average. The estimated participation rate for leaf collection was more than 75 percent in the cities and towns in Delaware where pickup services were available. The opposite seems to be true for grass clippings. An estimated 75 percent of the homeowners choose to manage some portion of their grass clipping on-site (source reduce) and 25 percent of homeowners are estimated to only participate in grass collection options. Although yard trimmings generation in Delaware is above the national average, it should be noted that the national average is lower than in the past because of the numerous states that ban yard trimmings from landfills.

Per Capita MSW Generation

Based on the estimate of total MSW generation in 2000, the corresponding average per capita generation rate for MSW in Delaware was estimated at 5.75 pounds per person per day (ppd) or 1.05 tons per person per year. Delaware's per capita MSW rate in 2000 was 25 percent higher than the national rate estimated in 1999 at 4.62 ppd (0.843 tons per capita per year). Delaware's generation of miscellaneous durables and wood packaging was estimated to be 26 and 16 percent higher than average national generation rates respectively.

Residential/Commercial MSW Generation

Of the 822,900 tons of MSW generated in Delaware in 2000, approximately 62 percent was estimated from residential/household sources and 38 percent was estimated from non-residential sources. Table 2 estimates the source of MSW for the 50 component categories. Some components come from residential sources but are taken to the commercial sector prior to collection for recycling or disposal. Examples of this are appliances, tires, and batteries, which are generated from the commercial sector when new products are purchased. Estimation of the source of individual products (i.e., residential/commercial) was based on information obtained from industry sources as well as Franklin Associates estimates utilized in previous reports (see Table 2).

SELECTED CONSUMER ELECTRONICS GENERATION

Methodology

Generation, in units, of select consumer electronics in Delaware was based on the national database used by Franklin Associates for the U.S. EPA. This database uses published data on shipments of individual consumer electronic products (adjusted for imports and exports) for the years 1984 to 2001. Shipments after 2001 were estimated from a trend analysis based on historical shipment data. Generation of consumer electronics, in units, represents the products that have reached the end of their useful life and are ready to be placed into storage, recycled or disposed.

Table 2
DELAWARE RESIDENTIAL AND COMMERCIAL MUNICIPAL WASTE STREAM

	MSW (1)	Residential (2)		Commercial (2)	
	2000 (tons/yr)	(tons/yr)	%	(tons/yr)	%
Products					
Durable Goods					
Major Appliances	11,500	1,150	10	10,350	90
Small Appliances	2,700	2,570	95	130	5
Furniture and Furnishings	25,000	20,000	80	5,000	20
Carpets and Rugs	7,100	5,680	80	1,420	20
Rubber Tires	14,000	2,100	15	11,900	85
Batteries, lead acid	5,900	300	5	5,600	95
Miscellaneous Durables					
Selected Consumer Electronics	5,100	4,080	80	1,020	20
Other Miscellaneous Durables	46,000	36,800	80	9,200	20
<i>Miscellaneous Durables</i>	51,100	40,880	80	10,220	20
Total Durable Goods	117,300	72,680	62	44,620	38
Nondurable Goods					
Newspapers	33,100	28,140	85	4,960	15
Books	3,200	2,560	80	640	20
Magazines	7,400	4,810	65	2,590	35
Office Papers	25,400	3,050	12	22,350	88
Telephone Directories	2,100	1,260	60	840	40
Third Class Mail	15,300	9,950	65	5,350	35
Other Commercial Printing	18,000	11,700	65	6,300	35
Tissue Paper and Towels	9,300	5,580	60	3,720	40
Paper Plates and Cups	2,700	540	20	2,160	80
Plastic Plates and Cups	2,600	520	20	2,080	80
Trash Bags	2,700	2,570	95	130	5
Disposable Diapers	9,000	8,100	90	900	10
Other Nonpackaging Paper	13,300	6,650	50	6,650	50
Clothing and Footwear	20,800	12,480	60	8,320	40
Towels, Sheets and Pillowcases	2,200	1,980	90	220	10
Other Miscellaneous Nondurables	10,700	5,350	50	5,350	50
Total Nondurable Goods	177,800	105,240	59	72,560	41
Containers and Packaging					
Glass Packaging					
Beer and Soft Drink Bottles	10,300	8,240	80	2,060	20
Wine and Liquor Bottles	5,200	4,160	80	1,040	20
Food and Other Bottles & Jars	10,800	9,180	85	1,620	15
Total Glass Packaging	26,300	21,580	82	4,720	18
Steel Packaging					
Beer and Soft Drink Cans	Neg.	Neg.		Neg.	
Food and Other Cans	7,600	6,460	85	1,140	15
Other Steel Packaging	700	40	5	660	95
Total Steel Packaging	8,300	6,500	78	1,800	22

Table 2 continued
DELAWARE RESIDENTIAL AND COMMERCIAL MUNICIPAL WASTE STREAM

	MSW (1) 2000 (tons/yr)	Residential (2)		Commercial (2)	
		(tons/yr)	%	(tons/yr)	%
Aluminum Packaging					
Beer and Soft Drink Cans	4,400	2,640	60	1,760	40
Other Cans	100	50	50	50	50
Foil and Closures	1,100	990	90	110	10
Total Aluminum Packaging	5,600	3,680	66	1,920	34
Paper & Paperboard Pkg					
Corrugated Boxes	98,000	9,800	10	88,200	90
Beverage Cartons	2,100	1,050	50	1,050	50
Folding Cartons	15,600	9,360	60	6,240	40
Other Paperboard Packaging	700	350	50	350	50
Bags and Sacks	4,700	4,230	90	470	10
Other Paper Packaging	4,900	3,430	70	1,470	30
Total Paper & Board Pkg	126,000	28,220	22	97,780	78
Plastics Packaging					
Soft Drink Bottles	2,300	1,840	80	460	20
Natural HDPE Bottles	1,900	1,860	98	40	2
Other Containers	7,600	6,080	80	1,520	20
Bags and Sacks	4,900	4,410	90	490	10
Wraps	7,300	5,840	80	1,460	20
Other Plastics Packaging	7,700	6,160	80	1,540	20
Total Plastics Packaging	31,700	26,190	83	5,510	17
Wood Packaging	25,600	0	0	25,600	100
Other Misc. Packaging	700	490	70	210	30
Total Containers & Pkg	224,200	86,660	39	137,540	61
Total Product Wastes	519,300	264,580	51	254,720	49
Other Wastes					
Food Wastes	78,800	47,280	60	31,520	40
Yard Trimmings	215,100	193,600	90	21,500	10
Miscellaneous Inorganic Wastes	9,700	4,850	50	4,850	50
Total Other Wastes	303,600	245,730	81	57,870	19
Total MSW Generated - Weight	822,900	510,310	62	312,590	38
Total MSW Generated - tons/person/yr	1.050	0.651		0.399	
Total MSW Generated - lbs/person/yr	2,100	1,302		798	
Total MSW Generated - lbs/person/day	5.8	3.6		2.2	

Generation is before materials recovery or combustion. MSW does not include construction and demolition debris, industrial process wastes, or certain other wastes.

Details may not add to totals due to rounding.

Delaware Population 2000

783,600

(1) Table 1.

(2) *Characterization of Municipal Solid Waste In The United States: 1997 Update.*

Keep America Beautiful, Inc. The Role Of Recycling In Integrated Solid Waste Management To The Year 2000.

Source: Franklin Associates, Ltd.

The methodology combines data from two sources: (1) The Consumer Electronics Association (CEA); and (2) the U.S. Department of Commerce trade data. The consumer electronics selected for this analysis are those categories where historical data are available. For example, pagers and radar detectors were not included because of lack of data. It should be noted that consumer electronics estimated separately in this analysis (by units) are included in the “Miscellaneous Durables” MSW category (by weight) shown in Tables 1 and 2. Additionally, those consumer electronics not estimated separately in this section are also accounted for (by weight) in the “Miscellaneous Durables” MSW category.

Individuals and some businesses often store obsolete or unused products. The reasons for storage include reluctance to throw away products that are still operational or products that, just a few years before, costs hundreds of dollars. Another reason may be the lack of an infrastructure to deal with the unused or obsolete products. The generation estimated in this section includes the amount of consumer electronics available for recycling and disposal as well as an undetermined amount of stored products.

Since consumer electronics sold in 2000 do not represent the consumer electronics entering the waste stream in 2000, a time series was developed based on expected life spans. Table 3 shows the products included in this analysis and the estimated life. The estimated life span includes primary and, when applicable, secondary use (reuse) of a product. Reuse of consumer electronic products thus is taken into account in the methodology.

Consumer electronics repair shops provided estimates on life span of all audio and video products. Telephone repair shops provided estimates for life spans of cordless/corded telephones and wireless telephones.

Estimated computer and computer monitor life spans found in the *Electronic Product Recovery and Recycling Baseline Report* for the National Safety Council were used. Estimated life spans for all other computer peripherals, such as personal work processors, printers, fax machines, and fax modems were based on data gathered from trade associations and businesses.

Televisions have an average life span of 13 to 15 years—the longest life span of the consumer electronics studied. Wireless telephones have the shortest life span—2 to 4 years. The methodology for this analysis used the life span and number of shipments to determine the generation for a particular year.

Table 3
Estimated Life of Selected Consumer Electronics
(in years)

	Range of Primary and Secondary Use Life Expectancy
Video Products	
Direct View Color TV	13-15
Projection TV	13-15
LCD Color TV	13-15
Videocassette Players	7 to 10
VCR Decks	7 to 10
Camcorders	7 to 10
Laserdisc Players	7 to 10
Home and Portable Audio Products	
Rack Audio System	3 to 15
Compact Audio System	3 to 15
Portable CD	3 to 15
Portable Headset Audio	3 to 15
CD Players	3 to 15
Home Radios	3 to 15
Mobile Electronics	
Wireless Telephones	2 to 4
Home Information Products	
Cordless/Corded Telephones	3 to 6
Telephone Answering Machines	3 to 6
Fax Machines	3 to 6
Personal Word Processors	3 to 6
Personal Computers	3 to 6
Computer Printers	3 to 5
Computer Monitors	6 to 7
Modem/Fax Modems	3 to 6

Source: Franklin Associates, Ltd.

As an example of the methodology, consider VCR generation. VCRs have an estimated lifespan of 7 to 10 years, which corresponds to shipments made from 1990 to 1993. The average VCR shipments during 1990 to 1993 were used to estimate generation in 2000. The generation of other consumer electronics was estimated similarly based on the expected life of the individual products.

Generation

Table 4 displays the generation of consumer electronics in number of units for the years 2000 projected through 2005. Since shipment data were not available for years past 2001, trending analyses from historical data were performed to estimate shipments in 2002 and 2003. This trending was necessary for products with shorter life spans such as wireless telephones. The 2005 generation estimate for wireless phones is an average of the cell phones shipped during 2001 through 2003. Caution should be utilized when applying the projected numbers where trending was used.

Trending was performed on the following categories of consumer electronics:

- Modems/fax modems
- Computer printers
- Personal computers
- Word processors
- Fax machines
- Answering machines
- Corded/cordless phones
- Wireless phones
- Home radios
- Total CD players
- Portable headset audio
- Portable CD

Caution should be used when using the projected numbers for the above categories, as trending will not take into account anomalies in the marketplace, such as rapid changes in products and new technology taking the market of established products. For example, the wireless phone market skyrocketed in 2001; the units shipped more than doubled from previous years. Although the trend function predicted a decrease in the number of shipments in 2002 and 2003, these estimates were still considerably higher than historical shipments of wireless telephones. The corded/cordless phone category also has market anomalies that make the trend function questionable. The units shipped for corded/cordless phones had been increasing since 1994, but in 2001 the shipped units dropped by 11 percent. It is difficult to know what the actual trend will be in the next few years for corded/cordless phones.

The estimated units generated in Delaware (Table 4) are the U.S. averages distributed to Delaware based on population. The economic indicators shown in Table 5 would suggest that Delaware's generation of consumer electronics is higher than would be predicted from the U.S. average. No quantification of this difference was attempted.

Table 4
Estimated Potential Generation Selected Consumer Electronics, 2000 to 2005

Delaware (units)									
Video Products									
Year	Televisions	VCRs	Camcorders	Laserdisc					
				Players					
2000	76,170	38,700	8,200	600					
2001	72,540	41,800	8,500	700					
2002	70,120	44,000	9,000	700					
2003	68,260	46,100	9,600	700					
2004	68,600	49,700	10,000	500					
2005	70,350	54,000	10,400	300					
Audio Products									
Year	Rack Audio	Compact	Portable CD	Portable					
		Audio		Headset					
	System	System		Audio	CD Player	Home Radios			
2000	3,800	9,400	27,800	69,800	52,700	55,900			
2001	3,600	11,600	34,700	72,000	63,800	55,800			
2002	3,200	13,400	41,600	73,100	74,600	54,200			
2003	2,800	15,000	46,200	74,700	88,100	54,200			
2004	2,300	17,200	54,200	76,600	99,600	53,800			
2005	1,800	19,900	60,500	78,400	111,900	53,300			
Information Products									
Year	Wireless	Corded/ Cordless	Answering	Fax	Word	Personal	Computer	Computer	Modems/ Fax
	Telephones	Phones	Machines	Machines	Processors	Computers	Printers	Monitors	Modems
2000	35,200	131,100	49,800	23,900	11,300	57,000	31,700	53,700	14,400
2001	39,800	148,000	51,600	24,500	10,000	64,400	48,100	64,800	19,800
2002	45,800	168,400	54,000	23,700	9,200	76,500	71,000	77,200	23,900
2003	83,200	188,600	57,800	21,700	6,800	92,400	96,000	84,100	27,700
2004	106,700	196,100	59,300	19,500	4,600	111,400	115,200	91,400	31,500
2005	134,800	205,900	62,200	17,900	4,000	131,900	131,800	106,600	35,500

Population		Adjusted
Delaware	Projections	Population Projections
2000	760,693	783,600
2001		790,297
2002		796,995
2003		803,692
2004		810,390
2005	793,201	817,087

www.state.de.us/dedo/new_web_site/Demographic_Data. Data series June 29, 2000.

2000 data. Census 2000 PHC-T-2. Ranking Tables for States: 1990 and 2000. Table 1.

Delaware projections (based on 1990 census) were adjusted with the 2000 census data from the Census Bureau.

Same percent increase assumed by Delaware Department of Economic Development was assumed for the adjusted projections.

Years 2001 through 2004 were extrapolated from 2000 and 2005.

Franklin Associates, Ltd.

Table 5
Economic Indicators Delaware versus U.S.

	Sales (\$1,000)		Delaware as % of U.S.
	US total	Delaware total	
1992 SIC 573 Radio, TV, Consumer Electronics, and Music Stores	\$34,886,749	\$115,559	0.33%
1997 NAICS 44312 Computer and Software Stores	\$24,058,663	\$146,823	0.61%
1997 NAICS 443112 Radio, TV, and other Electronics Stores	\$32,168,084	\$112,554	0.35%
2000 NAICS 443 Electronics and Appliances	\$88,676,000	\$412,000	0.46%
2000 Population	281,422,000	783,600	0.28%
2000 Households	104,705,000	299,000	0.29%
% of Households with Computers	U.S.	Delaware	
1998	42%	41%	
2000	51%	59%	

Source:

1997 Economic Census. www.census.gov/epcd/ec97sic/E97SDEG.HTM

1997 Economic Census. www.census.gov/epcd/ec97sic/E97SUSG.HTM

1997 Economic Census: Retail Trade - United States www.census.gov/epcd/ec97/us/US000_44.HTM

1997 Economic Census: Retail Trade - Geographic Area Series--Delaware. Oct. 1999. EC97R44A-DE

2001 Statistical Abstract. Tables 18, 56, 124, and 1159.

Franklin Associates, Ltd.

SELECT NON-MUNICIPAL SOLID WASTE

METHODOLOGY

Construction and Demolition Debris (C&D)

Building-Related C&D Debris. Building-related C&D debris is waste generated when structures are built, renovated, or demolished. Structures include all residential and nonresidential buildings. The methodology for estimating Delaware's generation of C&D debris follows the methodology used by the U.S. EPA for estimating national generation of C&D debris (EPA, 1998). The methodology combines Census Bureau data on construction industry project activity with point source waste assessment data (i.e., waste sampling and weighing at a variety of construction and demolition sites) to estimate the amount of C&D debris produced.

Residential construction data provided by the Delaware State Housing Authority were used to estimate generation of residential construction debris. Demolition and renovation permits, also provided by the State Housing Authority, were used to estimate generation of demolition and renovation debris from residential sources.

Nonresidential demolition and renovation permits issued in Delaware were used to estimate generation of nonresidential demolition and renovation debris. Nonresidential demolition and renovation permits are handled on the county and city levels in Delaware. Permits are not required at all in Sussex County. Kent and New Castle Counties handle permits for unincorporated parts of their counties. Five cities in Kent County and five cities in New Castle County handle permits within their city limits. Since data were not complete for these categories, waste quantities, scaled by population, were estimated by assuming the number of permits issued by New Castle are representative of the cities in that county and the number issued by Kent County are representative of the remainder of the state.

Street and Highway Waste. Public works projects, such as streets and highways, bridges, piers, and dams, generate large quantities of concrete and asphalt. Delaware's generation of street and highway waste was based on the number of miles of roadways in Delaware compared to the U.S. miles of roadways. National generation of street and highway waste is not known. Since recovery levels of this waste are generally very high, this factor was applied to the estimated national recovered concrete amounts and this was assumed to equal generation in Delaware. Delaware-specific information on asphalt recovery was obtained through phone interviews.

Used Oil and Oil Filters

Used oil in this analysis refers to spent automotive lubricating oil used in automobiles and trucks. Not included are spent lubricating oils from industrial users. The process of estimating the amount of used oil generated in Delaware was based on statistics from the Federal Highway Administration and "National Petroleum News". The number of motor vehicles registered in Delaware was multiplied by the estimated number of oil changes per vehicle. It was assumed that, on the average, motor vehicle oil is changed every 6,500 miles. The annual miles driven in Delaware per vehicle registered were divided by 6,500 miles to determine the average number of oil changes per vehicle. Automotive used oil generation in the state was then calculated by allowing for oil burned or otherwise lost to the environment during use. It was also assumed that a used oil filter was generated with every oil change.

This methodology does not account for used oil and oil filters removed from scrap automobiles. On a national level, salvaged motor vehicle generation in 1998 was equal to 5 percent of motor vehicle registrations in the same year. This percentage was applied to Delaware's motor vehicle registrations in 2000 to estimate the generation of oil and oil filters from salvaged motor vehicles.

GENERATION**Construction and Demolition Debris (C&D)**

The estimated generation of construction and demolition debris for Delaware and its three counties is shown in Table 6. In 2000 Delaware generated an estimated 832,200 tons of construction and demolition debris. Of this total generation, New Castle County generated 39 percent, Kent County generated 25 percent, and Sussex County generated 36 percent. Specific categories of construction and demolition debris include the following:

- Residential construction, renovation, and demolition
- Nonresidential construction, renovation, and demolition
- Road and highway waste

The following sections discuss the state and county generation for specific categories of construction and demolition debris.

Table 6

DELAWARE CONSTRUCTION & DEMOLITION DEBRIS ESTIMATES (1)				
	NEW CASTLE COUNTY Generation (tons/yr) 2000	KENT COUNTY Generation (tons/yr) 2000	SUSSEX COUNTY Generation (tons/yr) 2000	DELAWARE (3) Generation (tons/yr) 2000
Residential				
Construction	7,900	3,400	9,200	20,500
Renovation	6,600	1,400	4,300	12,400
Demolition	8,800	6,300	4,400	19,500
Total Residential	23,300	11,100	17,900	52,400
Nonresidential				
Construction	4,000	1,000	1,200	6,200
Renovation	49,500	600	15,500	65,600
Demolition	118,700	122,000	150,900	391,600
Total Nonresidential	172,200	123,600	167,600	463,400
Total Building Related	195,500	134,700	185,500	515,800
Road & Highway	125,800	72,400	118,200	316,400
Total C&D	321,300	207,100	303,700	832,200

(1) Tables A-20 through A-25. Delaware Asphalt Pavement Association data.

(2) C&D for county roads and highways was estimated by multiplying the total road and highway C&D for Delaware by the percentage of lane miles that each state has compared to the state total. Lane mile data from the Delaware DOT (DelDOT) division of planning.

(3) Due to rounding, state totals may not agree exactly with the sum of the county totals.

Source: Franklin Associates.

Residential Building-Related C&D Debris

As shown in Table 6, Delaware's total residential construction, demolition, and renovation debris generation in 2000 is estimated to be 52,400 tons. Of this estimated generation, New Castle County accounts for 44 percent, Kent County accounts for 21 percent, and Sussex County accounts for 35 percent. Specific trends in residential building activity are discussed below.

Residential Construction Debris. Between 1987 and 2000 most new construction is single-family homes. The most recent peak in the production of single-family homes was in 1999, when approximately 4,800 single-family homes were produced. In 2000 the production of single-family housing was approximately 3,950 units, the first time since 1991 that single-family housing production dropped below 4,000 units. The most recent peak in the production of multi-family homes was in 1998, when approximately 970 multi-family units were produced. The production of multi-family units decreased to 630 units in 1999, but rebounded to 950 units in 2000. The greatest peak in our data set, which ranges from 1987 to 2000, is in 1988 when 5,700 and 1,600 single-family and multi-family homes were produced, respectively.

There were approximately 4,900 residential construction permits (including single-family and multi-family homes) issued in Delaware in 2000. Based on an estimated average house size of 1,900 square feet and the generation rate of 4.4 pounds per square foot of floor space, Delaware's 2000 generation of residential construction waste is estimated at about 20,500 tons. Of this generation, New Castle County accounts for 39 percent, Kent County accounts for 17 percent, and Sussex County accounts for 44 percent.

Residential Renovation Debris. Renovation (or remodeling) includes improvements and repairs to existing buildings. Renovation debris consists of both construction and demolition type materials. Remodeling waste quantities are generally more variable in composition than construction or demolition waste. Renovation debris ranges from single materials being generated, such as when driveways or roofs are replaced, to multiple material generation, such as when buildings are modified or enlarged. Estimating generation per square foot is not very useful for remodeling waste.

An estimated 3,270 residential renovation permits were issued in Delaware in 2000. Assuming the same generation rate per dollar value of renovation as the national average results in an estimated generation rate of about 12,400 tons in 2000. Of this generation, New Castle County accounts for 54 percent, Kent County accounts for 11 percent, and Sussex County accounts for 35 percent.

Residential Demolition Debris. Residential demolition debris is generated when houses are torn down. There were 242 residential demolition permits issued in Delaware in 2000. Based on an estimated average size of houses that are demolished of 1,400 square feet, and a generation rate of 115 pounds per square foot of floor space, demolition debris generation in Delaware is estimated at 19,500 tons in 2000, about the same magnitude as residential construction debris. Of this generation, New Castle County accounts for 45 percent, Kent County accounts for 32 percent, and Sussex County accounts for 23 percent.

Nonresidential Building-Related C&D Debris

As shown in Table 6, Delaware generated an estimated 463,400 tons of nonresidential construction, demolition, and renovation debris in 2000. Of this generation, New Castle County accounts for 37 percent, Kent County accounts for 27 percent, and Sussex County accounts for 36 percent. Specific trends in nonresidential building activity are discussed below.

Nonresidential Construction Debris. The nonresidential construction industry in Delaware was evaluated by type, size, and value of buildings for 1999 and 2000. Nonresidential construction data was available only on the state level, not on the county level. The total floorspace of new nonresidential construction in Delaware is approximately one-third the size of residential construction. The generation rate of construction waste, based on the national study, is 3.89 pounds per square foot of building floor space. Assuming that factor applies for Delaware, the estimated generation rate is 6,200 tons in 2000. Of this generation, New Castle County accounts for 65 percent, Kent County accounts for 16 percent, and Sussex County accounts for 19 percent.

Nonresidential Demolition and Renovation Debris. Data was collected for the number and valuation of nonresidential demolition and renovation permits issued in Delaware in 1996, 1997, and 2000. An estimated 389 nonresidential demolition permits were issued in Delaware in 2000.

As shown in Table 6, Delaware's estimated nonresidential demolition generation was 391,600 tons in 2000. Of this generation, New Castle County accounts for 30 percent, Kent County accounts for 31 percent, and Sussex County accounts for 39 percent.

As shown in Table 6, Delaware's estimated nonresidential renovation generation was 65,600 tons in 2000. New Castle County accounts for 75 percent, Kent County accounts for 9 percent, and Sussex County accounts for 16 percent.

Road and Highway Waste

As shown in Table 6, Delaware generated an estimated 316,400 tons of construction and demolition debris from road and highway activity in 2000. Of this estimated generation, New Castle County generated 125,800 tons, Kent County generated 72,400 tons, and Sussex County generated 118,200 tons.

The amount of concrete generated nationally is not known, but the Construction Materials Recycling Association (CMRA) estimates that 100 million tons of concrete are recycled nationally on an annual basis. There are 5,779 miles of streets and highways in Delaware, which represents about 0.15 percent of the total roadways in the United States. Prorating to Delaware on the basis of road mileage, about 147,000 tons of concrete are recycled in Delaware annually. Since concrete recycling rates are generally very high, generation is also estimated to be 147,000 tons per year.

According to the Delaware Asphalt Pavement Association, 169,600 tons of asphalt were recycled in Delaware in 2000. Since asphalt recycling rates are generally very high, generation is also estimated to be 169,600 tons per year.

The lane mileage of each county in Delaware was used to allocate road and highway generation to each county. Delaware has 12,424 lane miles of road. Of this total lane mileage, New Castle County accounts for 40 percent, Kent County accounts for 23 percent, and Sussex County accounts for 37 percent.

Used Oil and Oil Filters

Used automotive oil generation in Delaware is estimated at 5,930 tons in 2000. Approximately 2 percent of the generation is estimated to be from salvaged automobiles. Annual generation in Delaware of used oil filters is estimated at 700 tons. It was assumed that a used oil filter was generated for each oil change. The weight of used oil filters after oil, to the extent possible, has been removed was based on DSWA recovery data.

LIMITATION OF GENERATION DATA

A concern of using the characterization methodology in this analysis is matching the time period of the data sources and the desired analysis year. Published data sources may be one or two years earlier than the year of the analysis. The assumption made in this report is that individual component generation rates or factors used to determine those generation rates remained constant. Estimations will be affected by changes in the economy and buying patterns. For this reason, if future studies are compared against this study, any obvious changes in the economy or buying patterns should be taken into account and adjustments should be made to the earlier study based on the latest data.

Another concern is applying national averages to Delaware. The level of detail provided by data sources is often limited to the U.S. as a total. Estimates must then be reviewed for economic and social differences. For example, Delaware's deposit legislation appears to impact the mix of beer containers. Therefore using the national mix of beer containers would not have been appropriate for Delaware's generation estimate.

Sampling studies, which are often used to estimate generation, are conducted at the point of disposal. These studies usually do not account for certain segments of MSW such as materials that are recovered and bulky items that are too large to handle. Allowances must also be made when processing the data from field sampling to account for moisture transfer that occurs when wet materials (such as food waste) are mixed with dry materials (such as paper). Other difficulties include obtaining a proper representation of residential versus non-residential samples and accurately accounting for seasonal differences. Also, the physical limitations and costs of field sampling usually result in dividing the wastes into fewer than 50 categories.

Moisture is also added to MSW discards from product use and rainfall. Liquids left in beverage containers, especially aluminum cans and plastic soda bottles, can greatly impact an individual category weight. Commercial wastes from fast food restaurants are particularly impacted from consumers throwing away cups still containing ice and beverage. The amount of rainfall adding to the weight of MSW depends on the storage of MSW at the point of generation. No references to the magnitude of this impact could be identified.

CHANGES IN GENERATION RATES

This section discusses the MSW and non-MSW categories that exhibited significant changes in generation rates between 1997 and 2000. Changes in MSW generation between 1997 and 2000 were calculated on a per capita basis. Since total generation is affected by population change (a larger population generates more solid waste) it is appropriate to normalize the changes by comparing data on a per capita basis.

The per capita percent change in Delaware was also compared to the per capita percent change in the U.S. average. Some of the differences between Delaware and the U.S. arise because the methodology uses the population ratio between Delaware and the U.S. to estimate Delaware's generation from the national value. In such cases the difference in generation between Delaware and the U.S. can be attributed to the faster rate of population growth in Delaware. Between 1997 and 2000, Delaware's population increased by 6.6 percent, while the U.S. population increased by 5.1 percent.

Besides population, there are other variables that affect MSW generation. The methodology also considers variables such as the cost of living, types of industries, packaging preferences, and other characteristics that vary regionally. For categories where such variables are similar to those on the national level, MSW generation is similar between Delaware and the U.S. For categories where Delaware has unique patterns for such variables, Delaware's MSW generation is different than the national trend.

The following criteria were used for determining whether a MSW category had a significant change between 1997 and 2000.

- The generation rates for the U.S. and Delaware went in opposite directions between 1997 and 2000. In other words, the U.S. generation rate increased while the Delaware generation rate decreased, or vice versa. Opposing trends were considered significant only when the absolute difference of the percent change between the U.S. and Delaware was greater than five percent.
- The percent change for the Delaware generation rate was at least 30% greater than the percent change for the U.S. generation rate. This indicates a change other than can be explained by the different population growth rates of the U.S. and Delaware.
- Delaware's generation rate increased by greater than seven percent. This would indicate a change that cannot be attributed solely to Delaware's population growth rate or 6.6% between 1997 and 2000.
- Delaware's generation rate decreased. Such decreases in Delaware's generation rate can usually be attributed to a decreasing rate on the national level.

The percent changes in MSW generation rates between 1997 and 2000 are shown in Table 7.

CHANGES IN MSW CATEGORIES

This section discusses the MSW categories that demonstrated significant changes in generation rates between 1997 and 2000.

Durable Goods

Delaware's generation rates of the following durable goods changed significantly between 1997 and 2000:

- Small appliances
- Rubber tires
- Batteries, lead acid
- Total miscellaneous durables.

Table 7

PERCENT CHANGE BETWEEN 1997 AND 2000 FOR PRODUCTS GENERATED IN THE MUNICIPAL WASTE STREAM (1)

	Delaware 1997 (lb/per- son/yr)	Delaware 2000 (lb/per- son/yr)	Delaware Percent Change	U.S. 1997 (lb/per- son/yr)	U.S. 1999 (lb/per- son/yr)	U.S. Percent Change
Products						
Durable Goods						
Major Appliances	29	29	1.2%	27	27	0.0%
Small Appliances	6.0	6.9	14.9%	6.0	6.9	14.9%
Furniture and Furnishings	63	64	1.3%	56	57	1.0%
Carpets and Rugs	18	18	0.7%	18	18	0.6%
Rubber Tires	33	36	8.3%	32	34	6.1%
Batteries, lead acid	15	15	0.4%	13	14	9.5%
Miscellaneous Durables						
Selected Consumer Electronics	na	13	na	na	13	na
Other Miscellaneous Durables	135	117	-13.0%	96	90	-6.6%
<i>Total Miscellaneous Durables</i>	135	130	-3.4%	96	103	6.8%
<i>Total Durable Goods</i>	299	299	0.1%	248	259	4.5%
Nondurable Goods						
Newspapers	87	84	-2.9%	101	109	8.0%
Books	8.0	8.2	2.1%	8.0	8.3	3.6%
Magazines	18	19	4.9%	16	16	1.3%
Office Papers	69	65	-6.0%	52	57	8.7%
Telephone Directories	4.0	5.4	34.0%	4.0	5.4	35.7%
Third Class Mail	36	39	8.5%	36	39	8.4%
Other Commercial Printing	51	46	-9.9%	51	46	-9.8%
Tissue Paper and Towels	22	24	7.9%	22	24	8.0%
Paper Plates and Cups	7.0	6.9	-1.6%	7.0	7.0	-0.5%
Plastic Plates and Cups	6.0	6.6	10.6%	6.0	6.7	11.2%
Trash Bags	7.0	6.9	-1.6%	7.0	7.0	-0.5%
Disposable Diapers	22	23	4.9%	23.5	24.3	3.3%
Other Nonpackaging Paper	31	34	9.5%	31	34	9.3%
Clothing and Footwear	40	53	32.7%	43	46	6.6%
Towels, Sheets and Pillowcases	6.0	5.6	-6.4%	6.0	5.7	-4.7%
Other Miscellaneous Nondurables	26	27	5.0%	26	27	5.2%
<i>Total Nondurable Goods</i>	440	454	3.2%	440	462	5.1%
Containers and Packaging						
Glass Packaging						
Beer and Soft Drink Bottles	20	26	31.4%	37	41	11.4%
Wine and Liquor Bottles	17	13	-21.9%	14	15	5.3%
Food and Other Bottles & Jars	29	28	-4.9%	29	28	-4.7%
<i>Total Glass Packaging</i>	67	67	0.2%	80	84	4.5%
Steel Packaging						
Beer and Soft Drink Cans	Neg.	Neg.		Neg.	Neg.	
Food and Other Cans	21	19	-7.6%	21	20	-7.1%
Other Steel Packaging	1.0	1.8	78.7%	1.0	1.8	76.0%
<i>Total Steel Packaging</i>	22	21	-3.7%	22	22	1.2%

Table 7 continued
PRODUCTS GENERATED IN THE MUNICIPAL WASTE STREAM

	Delaware 1997 (lb/per- son/yr)	Delaware 2000 (lb/per- son/yr)	Delaware Percent Change	U.S. 1997 (lb/per- son/yr)	U.S. 1999 (lb/per- son/yr)	U.S. Percent Change
Aluminum Packaging						
Beer and Soft Drink Cans	11	11	2.1%	11	11	2.0%
Other Cans	0.30	0.37	22.2%	0.30	0.37	22.2%
Foil and Closures	3	3	-6.4%	3	3	-7.1%
Total Aluminum Packaging	14	14	2.9%	14	14	0.5%
Paper & Paperboard Pkg						
Corrugated Boxes	219	250	14.2%	221	223	0.8%
Beverage Cartons	4.0	5.4	34.0%	3.0	3.5	16.1%
Folding Cartons	41	40	-2.9%	41	40	-2.8%
Other Paperboard Packaging	2.0	1.8	-10.7%	2.0	1.7	-14.7%
Bags and Sacks	15	12	-20.0%	15	12	-20.4%
Other Paper Packaging	10	13	25.1%	10	12	24.4%
Total Paper & Board Pkg	291	322	10.5%	292	292	0.1%
Plastics Packaging						
Soft Drink Bottles	6.0	5.9	-2.2%	6.0	5.9	-1.0%
Natural HDPE Bottles	4.0	4.8	21.2%	5.0	5.1	1.2%
Other Containers	10	19	94.0%	10	19	93.6%
Bags and Sacks	10	13	25.1%	10	12	23.9%
Wraps	14	19	33.1%	14	19	33.6%
Other Plastics Packaging	17	20	15.6%	17	20	15.6%
Total Plastics Packaging	61	81	32.6%	62	81	30.8%
Wood Packaging	48	65	36.1%	53	56	5.9%
Other Misc. Packaging	1.0	1.8	78.7%	1.0	1.7	68.7%
Total Containers & Pkg	504	572	13.6%	524	551	5.2%
Total Product Wastes	1,243	1,326	6.6%	1,212	1,273	5.0%
Other Wastes						
Food Wastes	165	201	21.9%	184	185	0.3%
Yard Trimmings	278	549	97.5%	207	203	-1.7%
Miscellaneous Inorganic Wastes	24	25	3.2%	24	25	3.3%
Total Other Wastes	467	775	65.9%	415	413	-0.6%
Total MSW Generated - Weight	1,710	2,100	22.8%	1,627	1,685	3.6%

(1) Data from Table 1

Neg. = negligible

Details may not add to totals due to rounding.

Delaware Population 2000: 786,300

U.S. Population 2000: 281,421,906

Source: Franklin Associates.

Small Appliances. The 14.9 percent increase in this category can be attributed to Delaware's population growth as well as an increasing generation rate on the national level.

Rubber Tires. The generation of rubber tires increased for both Delaware and the U.S. between 1997 and 2000. Delaware's generation of rubber tires increased by 8.3 percent, and the U.S. generation of rubber tires increased by 6.1 percent. The higher population growth rate in Delaware is partly responsible for the greater increase in generation for this category. The greater number of vehicle miles driven annually also explains why Delaware's generation of rubber tires has increased faster than the national rate. In 2000 Delaware's miles of vehicle travel was 0.30 percent of the total miles of vehicle travel in the U.S., while its population was only 0.28 percent of the total U.S. population.

Batteries, lead acid. Between 1997 and 2000, Delaware's per capita generation of lead acid batteries increased by only 0.4 percent, while the per capita generation of lead acid batteries increased by 9.5 percent nationally. The difference in the per capita generation rates of Delaware and the U.S. can be attributed to the different growth rates in motor vehicle registrations between the state and national levels. The increase in Delaware's motor vehicle registrations was less than the U.S. increase in motor vehicle registrations.

Total Miscellaneous Durables. Delaware's generation of total miscellaneous durables decreased by 3.4 percent between 1997 and 2000, while the U.S. generation for this category increased by 6.8 percent during the same time period. The generation for this category is partly based on retail sales data. Historically, Delaware's per capita retail sales have been higher than the national average. Although Delaware has a higher per capita generation, the change from 1997 to 2000 does not follow the U.S. growth trend.

Nondurable Goods

Delaware's generation rates of the following nondurable goods changed significantly between 1997 and 2000:

- Newspapers
- Magazines
- Office papers
- Telephone directories
- Third class mail
- Other commercial printing
- Plastic plates and cups
- Disposable diapers
- Other nonpackaging paper
- Clothing and footwear.

Newspapers. Delaware's generation of newspapers decreased by 2.9 percent between 1997 and 2000, but national generation for this category increased by 8.0 percent during the same time period. The methodology relies partly on circulation data in order to estimate generation for this category. Circulation data indicates that, on the basis of weight, newspapers distribution has decreased in Delaware, but has increased nationally. Additionally, between 1997 and 2000 the number of subscriptions to the Philadelphia Inquirer (the second largest newspaper by weight) were down in Kent and Sussex Counties.

Magazines. Delaware's generation of magazines increased by 4.9 percent between 1997 and 2000, but national generation for this category increased by only 1.3 percent during the same time period. The methodology relies partly on circulation data in order to estimate generation for this category. Circulation data indicates that, on the basis of weight, magazine distribution increased by a greater percentage in Delaware.

Office Papers. Delaware's generation of office papers decreased by 6.0 percent between 1997 and 2000, but national generation for this category increased by 8.7 percent. This comparison is misleading because the methodology relies partly on Delaware employment data in selected industries in order to estimate generation for this category, and between 1997 and 2000 the U.S. Census Bureau changed from the SIC (Standard Industry Classification) to the NAICS (North American Industry Classification System) methods for tracking employment. This change in methodology could impact the estimated changes in office paper generation. The opposing trends (a decrease for Delaware and an increase for the U.S.) in office paper generation between 1997 and 2000 may seem to contradict the increasing employment trends in Delaware. However, even though Delaware has a higher employment rate than the U.S., the employment rate increased at a greater rate for the U.S. between 1997 and 2000. Delaware's generation of office paper is calculated by taking a ratio of the total office paper generated in the U.S. Thus, the faster rate of employment growth in the U.S. explains why Delaware's per capita generation of office paper decreased even though Delaware's employment increased.

Telephone Directories. The 34 percent increase in this category can be attributed to Delaware's population growth as well as an increasing generation rate on the national level. Within the last ten years, the generation of telephone directories has followed a rising and falling pattern from year to year. For example, on the national level, in 1995 an estimated 430,000 tons of telephone directories were generated; in 1997 an estimated 410,000 tons of telephone directories were generated; in 1998 an estimated 640,000 tons of telephone directories were generated; in 1999 an estimated 570,000 tons of telephone directories were generated. Thus, while Delaware generated an estimated 2,100 tons of telephone directories in 2000, a 34 percent increase when compared to the 1997 estimate, the rising and falling pattern of generation for this category prevents us from concluding that a large increase in generation will happen every year.

Third Class Mail. The 8.5 percent increase in this category can be attributed to Delaware's population growth as well as an increasing generation rate on the national level.

Other Commercial Printing. Between 1997 and 2000, the per capita generation for other commercial printing decreased by 9.8 percent and 9.9 percent for Delaware and the U.S., respectively. On the national level, 1997 was a peak year for generation for this category. In 1997 the U.S. generated an estimated 7,000,000 tons of other commercial printing, while in 1999 it generated an estimated 5,940,000 tons. Similarly, in 1997 Delaware generated an estimated 18,800 tons of other commercial printing, while in 1999 it generated an estimated 18,000 tons.

Plastic Plates and Cups. The 10.6 percent increase in this category can be attributed to Delaware's population growth as well as an increasing generation rate on the national level.

Disposable Diapers. Between 1997 and 2000, the per capita generation of disposable diapers increased by 4.9 percent for Delaware and increased by 3.3 percent on the national level. The difference between the Delaware generation and U.S. generation rates can be attributed to Delaware's faster population growth as well as Delaware's increasing birthrates.

Other Nonpackaging Paper. The 9.5 percent increase in this category can be attributed to Delaware's population growth as well as an increasing generation rate on the national level.

Clothing and Footwear. Between 1997 and 2000, the per capita generation of clothing and footwear increased for both Delaware and the U.S., but the rate at which Delaware's per capita generation increased (32.7 percent) was much greater than that for the U.S. (6.6 percent). The methodology for calculating clothing and footwear is based on historical sales of clothing and apparel. Delaware has higher sales for clothing and footwear and a faster population growth rate, which explain why Delaware's estimated rate of generation for this category is greater than the U.S. trend. Delaware's estimated generation rate of clothing and footwear remains higher than the national average even after it sales data is adjusted according to Delaware's higher cost of living.

Glass Packaging

Delaware's generation rates of the following glass packaging changed significantly between 1997 and 2000:

- Beer and soft drink bottles
- Wine and liquor bottles
- Food and other bottles and jars.

Beer and Soft Drink Bottles. Between 1997 and 2000, the per capita generation of beer and soft drink bottles increased for Delaware and the U.S. by 31.4 percent and 11.4 percent, respectively. The weight of beer and soft drink bottles is especially sensitive to changes in packaging distributions. The large increase between Delaware's 1997 and 2000 generation is due to the change in percentages of the types of packaging materials, especially glass bottles. In 1997 glass was 15% of the Delaware beer market and in 2000 glass was 20% of the Delaware beer market.

Wine and Liquor Bottles. Delaware's generation of wine and liquor bottles decreased by 21.9 percent between 1997 and 2000, but generation of wine and liquor bottles increased in the U.S. by 5.3 percent during the same period. The methodology relies on regional consumption trends in order to estimate generation for this category. The per capita consumption of wine and liquor is higher in the Northeast region (which includes Delaware). Between 1997 and 2000, consumption trends for the Northeast region decreased slightly, but they were still greater than national consumption trends.

Food and Other Bottles and Jars. The decrease in the rate of Delaware's generation of food and other bottles and jars is due to a decrease on the national level. Between 1997 and 2000, the per capita generation of this category decreased 4.7 percent in the U.S. and 4.9 percent in Delaware.

Steel Packaging

Between 1997 and 2000, the per capita generation of other steel packaging increased significantly for Delaware and the U.S. Delaware's per capita generation for this category increased by 78.7 percent, and the U.S. per capita generation for this category increased by 76.0 percent. For this category, Delaware's generation is calculated from the generation rate on the national level.

Aluminum Packaging

Between 1997 and 2000, the per capita generation of other cans (in the aluminum packaging category) increased by 22 percent in Delaware. This large increase is due to a large increase on the national level. However, since this is a small category, any change in generation may seem magnified when expressed on a percentage basis.

Paper and Paperboard Packaging

Delaware's generation rates of the following paper and paperboard packaging changed significantly between 1997 and 2000:

- Corrugated boxes
- Beverage cartons
- Other paperboard packaging
- Bags and sacks
- Other paper packaging.

Corrugated Boxes. Between 1997 and 2000, the per capita generation of corrugated boxes increased significantly (14.2 percent) for Delaware, but increased slightly for the U.S. (0.8 percent). Delaware's generation of corrugated boxes was estimated by using Delaware-specific data. The concentration of retail businesses is higher in Delaware than in the U.S., which partly explains Delaware's greater generation of corrugated boxes.

Beverage Cartons. Between 1997 and 2000, the per capita generation of paper beverage cartons increased 34 percent in Delaware, but increased 16 percent in the U.S. Delaware's generation of beverage cartons was estimated by using Delaware-specific data. Regional packaging and beverage consumption trends are consistent with Delaware's increasing generation of beverage cartons.

Other Paperboard Packaging. Between 1997 and 2000, Delaware's generation of other paperboard packaging decreased by about 11 percent. This decrease can be attributed to a decrease on the national level.

Bags and Sacks. Between 1997 and 2000, both Delaware and the U.S. had a large decrease in bags and sacks generation. Delaware's generation of paper bags and sacks decreased by 20.0 percent, and the U.S. generation of paper bags and sacks decreased by 20.4 percent. Delaware's decreasing generation for this category is consistent with the national trend.

Other Paper Packaging. Between 1997 and 2000, both Delaware and the U.S. had a large increase in other paper packaging generation. Delaware's generation for this category increased by 25.1 percent, and the U.S. generation for this category increased by 24.4 percent. Delaware's increasing generation for this category is consistent with the national trend.

Plastics Packaging

Delaware's generation rates of the following plastics packaging changed significantly between 1997 and 2000:

- Soft drink bottles
- Natural HDPE bottles
- Other containers
- Bags and sacks
- Wraps
- Other plastics packaging.

Soft Drink Bottles. Delaware's generation of plastic soft drink bottles decreased 2.2 percent from 1997 to 2000, and the U.S. generation for this category decreased 1.0 percent during the same period. The methodology relies on regional consumption and packaging trends in order to estimate Delaware's generation for this category.

Natural HDPE Bottles. Delaware's generation of natural HDPE bottles increased by 21.2 percent from 1997 to 2000, and the U.S. generation for this category increased 1.2 percent during the same period. The methodology relies on regional consumption and packaging trends in order to estimate Delaware's generation for this category.

Other Containers. Between 1997 and 2000, both Delaware and the U.S. had a large increase in the generation of other containers for plastics packaging. Delaware's generation for this category increased by 94.0 percent, and the U.S. generation for this category increased by 93.6 percent. Delaware's increasing generation for this category is consistent with the national trend.

Bags and Sacks. Between 1997 and 2000, Delaware's generation of plastic bags and sacks increased by 25.1 percent, and the U.S. generation for this category increased by 23.9 percent. Delaware's increasing generation for this category is consistent with the national trend.

Wraps. Between 1997 and 2000, Delaware's generation of plastic wraps increased by 33.1 percent, and the U.S. generation for this category increased 33.6 percent. Delaware's increasing generation for this category is consistent with the national trend.

Other Plastics Packaging. Between 1997 and 2000, Delaware's generation of other plastics packaging increased 15.6 percent, and the U.S. generation for this category also increased 15.6 percent. Delaware's increasing generation for this category is consistent with the national trend.

Wood Packaging

Delaware's generation rate for wood packaging changed significantly between 1997 and 2000. Delaware's generation for this category increased by 36.1 percent, and the U.S. generation for this category increased by 5.9 percent. In 1997 Delaware's generation for this category was lower than the national average, but in 2000 Delaware's generation for this category was higher than the national average.

Food Wastes

Delaware's generation rate for food wastes changed significantly between 1997 and 2000. Delaware's generation for this category increased by 21.9 percent, and the U.S. generation for this category increased by only 0.3 percent. In 1997 Delaware's generation for this category was lower than the national average, but in 2000 Delaware's generation for this category was higher than the national average.

Yard Trimmings

Between 1997 and 2000, Delaware's per capita generation of yard trimmings increased by 97 percent, while U.S. generation of yard trimmings decreased by 1.7 percent. However, a change in the methodology for estimating Delaware yard trimmings generation in 2000 makes comparison between Delaware 1997 and 2000-generation values impossible.

CHANGES IN NON-MSW CATEGORIES

This section discusses the changes in generation for non-MSW categories.

Construction and Demolition Debris

The changes in Delaware's construction and demolition debris generation from 1997 to 2000 are shown in the following table.

Table 8

**CHANGE IN DELAWARE CONSTRUCTION & DEMOLITION DEBRIS
ESTIMATES FROM 1997 TO 2000 (1)**

	Generation (tons/yr)		Percent
	1997	2000	Change (2)
Residential			
Construction	20,100	20,500	2.0%
Renovation	11,600	12,400	6.9%
Demolition	21,400	19,500	-8.9%
Total Residential	53,100	52,400	-1.3%
Nonresidential			
Construction	3,500	6,200	77.1%
Renovation	52,000	65,600	26.2%
Demolition	155,700	391,600	151.5%
Total Nonresidential	211,200	463,400	119.4%
Total Building Related	264,300	515,800	95.2%
Road & Highway	182,000	316,400	73.8%
Total C&D	446,300	832,200	86.5%

(1) Tables A-20 through A-25, 1997 and 2000

(2) Percent Change = (2000 generation - 1997 generation) / (1997 generation) X 100%

Source: Franklin Associates.

Significant changes in C&D generation occurred for nonresidential and road and highway categories. The reasons for these changes are discussed below.

Nonresidential C&D. The generation of nonresidential C&D debris is estimated from the number of construction, renovation, and demolition permits issued per year. Delaware's number of nonresidential construction and demolition permits increased significantly between 1997 and 2000. Nonresidential renovation was the only source of C&D debris that did not increase significantly.

Between 1997 and 2000, the total number of Delaware's nonresidential construction projects increased from 230 to 262, a 14 percent increase. In terms of total square feet, Delaware's nonresidential construction increased from 1,815 square feet to 3,194 square feet, an increase of 76 percent. This increased activity in nonresidential construction increased the estimated generation of construction debris.

Nonresidential demolition increased significantly for Kent and Sussex counties. In 1997 there were an estimated 24 demolition permits issued in Kent County, while in 2000 there were an estimated 121 demolition permits issued in Kent County. In 1997 there were an estimated 26 demolition permits issued in Sussex County, while in 2000 there were an estimated 150 demolition permits issued in Sussex County. The increased number of demolition permits for these counties increased the estimated demolition debris for Delaware.

Road and Highway C&D. Between 1997 and 2000, Delaware's total road miles increased from 0.14 percent to 0.15 percent of the national total. This is a small increase that does not explain the large increase of road and highway C&D debris generated shown in the above table. In 1997 and 2000 the same method was used to calculate the weight of concrete generated from road and highway activity, but the amount of asphalt generated in 2000 was estimated from data provided by the Delaware Asphalt Pavement Association. Thus, the increase in road and highway C&D between 1997 and 2000 can be partly attributed to this new data source. Additionally, due to the irregularity of state and federal road and highway projects, the generation of debris from road and highway activity is a value that usually varies from year to year.

CHAPTER 2

SOLID WASTE RECOVERY

Recovery estimates of MSW and selected non-MSW were derived from a combination of sources. The Delaware Solid Waste Authority (DSWA) provided data from the Recycle Delaware program and the recyclers' annual reports. A sampling of recyclers, processors, end-users, state and local officials, commercial establishments, and industry contacts were interviewed by telephone to determine the extent of recycling in Delaware. Adjustments were made to the recovery data to avoid double counting and to eliminate industrial scrap, as well as material recovered by Delaware companies but generated in other states. A list of contacts from the telephone survey is included in Appendix C (non-respondents are not included on the list).

The information obtained from the data and the telephone survey was used to make comparisons to national recovery levels. For example, national recovery of OCC in 1999 was estimated at 65 percent of generation. Delaware data shows a 68 percent recovery rate of OCC, it would appear that Delaware is recovering OCC at a level higher than national average. Following the U.S. EPA methodology, if a category of products is known to be recovered in Delaware but sufficient data is unavailable; Delaware recovery is estimated by applying the estimated national recovery rate to Delaware generation (USEPA 1997).

MUNICIPAL SOLID WASTE

Table 9 shows estimated 2000 recovery of MSW in Delaware. Recovery was estimated by two methods dependent on the definition of recovery. The two methods were:

1. estimated recovery using EPA's definition of recovery through recycling and composting
2. estimated recovery using Delaware definition of resource recovery.

Recovery estimates ranged from 21 percent to 23 percent. The 21 percent estimate (using EPA definitions) compares to 28 percent in 1999 on the national level (FAL 2001). The highest recovery rates are estimated for major appliances, lead-acid batteries, newspapers, corrugated boxes, glass deposit containers, and aluminum cans. The second estimate (23 percent) includes tires recovered for energy and that part of major appliances which is not recyclable but is diverted from landfill disposal in Delaware. Neither source reduction or product reuse is included in any of the recovery estimates.

DURABLE GOODS

An estimated 21 percent of the durable goods generated in Delaware was collected for recycling and energy recovery. This compares to 25 percent on the national level when using the same recovery criteria. The EPA-published national recovery rate for durable goods was 17 percent in 1999 (EPA 2001). The difference between the EPA-published recovery rate and the national rate of recovery calculated for this study is that the higher recovery rate includes tires collected for energy recovery and that portion of major appliances that is not recycled and discarded before reaching the end market.

Major Appliances. The national recycling rate for appliances is 52 percent (EPA 2001). The EPA methodology accounts for that part of appliances that is recycled (mostly steel). According to the Steel Recycling Institute, major appliances were recovered at 84 percent in 2000. Eight-four percent represents the entire appliance including the components that are not recyclable. Since there are no shredders in Delaware, the non-recyclable portion of the appliances is being discarded in states other than Delaware. The published U.S. EPA recovery rate does not include that portion of major appliances that is not recycled since it is ultimately discarded. Recycle Delaware data suggests that major appliance recovery in Delaware is similar to the U.S. average.

Small Appliances, Furniture and Furnishings. On the national level, a small amount of ferrous metal in small appliances may be recovered through magnetic separation.

In the 1997 report, some MSW was taken to a waste-to-energy facility at Chester, PA (DSWA 1999). It was assumed that the only recovery of ferrous metal from small appliances in 1997 was by magnetic separation at the waste-to-energy facility. Since waste-to-energy was not utilized in 2000, no magnetic separation of ferrous metal from small appliances was assumed.

Nationally, the recovery of furniture and furnishings is less than 0.05 percent. The information obtained for this study indicated that there is no recovery of furniture and furnishings in Delaware. It should be noted that reuse of small appliances, furniture and furnishings is not considered recycling since the products eventually have to be discarded. The movement of products into the reuse market is accounted for in the generation methodology.

Carpets and Rugs. In 1999, U.S. carpet and rug recovery is estimated at about 1 percent. The DSWA reported that in 2000 there was some residential and commercial recovery of carpets in Delaware. Therefore it was assumed that Delaware was at national average for carpet and rug recovery. Similar to small appliances, and furniture and furnishings, reuse of carpets and rugs is not considered recycling.

Tires. Recovery of tires for this study includes tires combusted for energy. The national estimate of tire recovery, excluding energy recovery, is 27.6 percent (EPA 2001). The Scrap Tire Management Council reported that the national recovery rate (including energy recovery) for scrap tires was 66 percent in 1998. The national recovery level of tires on Table 9 includes energy recovery and therefore differs from the published EPA estimate (EPA 2001).

Recovery of tires was documented through DSWA landfill data and telephone contacts with generators and recyclers. It was assumed that all of the tires received at the landfill were either from residential sources or the Delaware Department of Transportation. According to landfill records, approximately 22 percent of the tires received by DSWA were from the Delaware Department of Transportation and were considered commercial recovery.

Data from generators and recyclers were adjusted to avoid double counting and to eliminate tires generated from outside of Delaware but recovered by Delaware recyclers. The amount of estimated tire recovery (residential and commercial) documented was 68 percent. This recovery rate is higher than the Scrap Tire Management Council's 1998 national estimate of tire recovery including energy for fuel.

Lead-acid Batteries. Although Delaware is one of six states that have not banned the disposal of lead-acid batteries from landfills (Raymond 2001), lead-acid battery recovery rates appear to be high. In 1998, generators reported that manufacturers/suppliers support an infrastructure that promotes recovery by taking used batteries from retailers when new stock is purchased. It was assumed, for this report that the same infrastructure existed in 2000. Assuming 99 percent of commercial lead-acid batteries and 30 percent of residential lead-acid batteries are recovered, the statewide recovery rate for lead-acid batteries in Delaware is estimated to be 96 percent.

Miscellaneous Durables. On the national level, approximately nine percent of consumer electronics were recovered in 1999. An additional five percents of other miscellaneous durables were estimated as recovered through magnetic separation at waste-to-energy facilities. In Delaware, only small amounts of commercial consumer electronics were identified as recovered. No residential recovery was documented. In 2001, the DSWA established a residential and commercial consumer electronics drop-off recycling program. This program accepts, computers, monitors and peripherals, TVs, stereo equipment, telecommunication equipment and electronic games.

The commercial consumer electronics that were recovered from Delaware sources in 2000 came from hospitals, schools, private businesses and government offices. Recovery of other miscellaneous durables through magnetic separation was assumed zero since waste-to-energy was not a disposal management option for Delaware in 2000.

Table 9
PRODUCTS RECOVERED FROM THE MUNICIPAL WASTE STREAM

	U.S. Recovery 1999 %	Delaware 2000 Recovery				Total Recovery %
		Residential		Commercial		
		Generation (tons/yr)	Recovery (tons/yr)	Generation (tons/yr)	Recovery (tons/yr)	
Products						
Durable Goods						
Major Appliances	84 **	1,150	970 *	10,350	8,690 *	84
Small Appliances	2.1	2,570	0 *	130	0 *	0.0
Furniture and Furnishings	Neg.	20,000	0	5,000	0	0.0
Carpets and Rugs	0.8	5,680	50	1,420	10	0.8
Rubber Tires	66 **	2,100	1,250 *	11,900	8,250 *	68
Batteries, lead acid	96	300	90	5,600	5,550	96
Miscellaneous Durables						
Selected Consumer Electronics	9.1	4,080	0	1,020	20 *	0.4
Other Miscellaneous Durables	5.3	36,800	0	9,200	0	0.0
Total Miscellaneous Durables	5.8	40,880	0	10,220	20	0.0
Total Durable Goods	25	72,680	2,360	44,620	22,520	21.2
Nondurable Goods						
Newspapers	54	28,140	12,160 *	4,960	3,730 *	48
Books	17	2,560	100	640	450	17
Magazines	25	4,810	2,080 *	2,590	640	37
Office Papers	47	3,050	0 *	22,350	10,290 *	41
Telephone Directories	18	1,260	540 *	840	150	33
Third Class Mail	26	9,950	2,550	5,350	1,370	26
Other Commercial Printing	20	11,700	2,290	6,300	1,230	20
Tissue Paper and Towels	Neg.	5,580	0	3,720	0	0
Paper Plates and Cups	Neg.	540	0	2,160	0	0
Plastic Plates and Cups	Neg.	520	0	2,080	0	0
Trash Bags	Neg.	2,570	0	130	0	0
Disposable Diapers	Neg.	8,100	0	900	0	0
Other Nonpackaging Paper	Neg.	6,650	0	6,650	0	0
Clothing and Footwear	14	12,480	1,720	8,320	1,150	14
Towels, Sheets and Pillowcases	18	1,980	350	220	40	18
Other Miscellaneous Nondurables	Neg.	5,350	0	5,350	0	0
Total Nondurable Goods	26	105,240	21,790	72,560	19,050	23
Containers and Packaging						
Glass Packaging						
Beer and Soft Drink Bottles	28	8,240	3,550 *	2,060	1,790	52
Wine and Liquor Bottles	22	4,160	470 *	1,040	580 *	20
Food and Other Bottles & Jars	26	9,180	1,050 *	1,620	410	14
Total Glass Packaging	26	21,580	5,070	4,720	2,780	30
Steel Packaging						
Beer and Soft Drink Cans	Neg.	Neg.		Neg.		
Food and Other Cans	57	6,460	670 *	1,140	150 *	11
Other Steel Packaging	71	40	30	660	470	71
Total Steel Packaging	58	6,500	700	1,800	620	16

NONDURABLE GOODS

An estimated 23 percent of the nondurable goods generated in Delaware was collected for recycling. This recovery rate compares to 26 percent on the national level. An additional 5,380 tons would need to be recovered to elevate the nondurable goods recovery to match national recovery.

Table 9 continued
PRODUCTS RECOVERED FROM THE MUNICIPAL WASTE STREAM

	U.S. Recovery 1999 %	Delaware 2000 Recovery				Total Recovery %
		Residential		Commercial		
		Generation (tons/yr)	Recovery (tons/yr)	Generation (tons/yr)	Recovery (tons/yr)	
Aluminum Packaging						
Beer and Soft Drink Cans	56	2,640	1,470	1,760	980	56
Other Cans	Neg.	50	0	50	0	0
Foil and Closures	7.9	990	20	110	70	8.2
Total Aluminum Packaging	45	3,680	1,490	1,920	1,050	45
Paper & Paperboard Pkg						
Corrugated Boxes	65	9,800	1,070 *	88,200	65,510	68
Beverage Cartons	Neg.	1,050	0	1,050	0	0
Folding Cartons	7.1	9,360	0	6,240	0	0
Other Paperboard Packaging	Neg.	350	0	350	0	0
Bags and Sacks	13	4,230	0	470	0	0
Other Paper Packaging	Neg.	3,430	0	1,470	0	0
Total Paper & Board Pkg	51	28,220	1,070	97,780	65,510	53
Plastics Packaging						
Soft Drink Bottles	36	1,840	520 *	460	30 *	24
Natural HDPE Bottles	32	1,860	590 *	40	0	31
Other Containers	11	6,080	290 *	1,520	0	4
Bags and Sacks	0.6	4,410	0	490	0	0
Wraps	5.1	5,840	0	1,460	370	5.1
Other Plastics Packaging	2.6	6,160	0	1,540	200	2.6
Total Plastics Packaging	9.1	26,190	1,400	5,510	600	6
Wood Packaging	6.4	0	0	25,600	1,640	6.4
Other Misc. Packaging	Neg.	490	0	210	0	0
Total Containers & Pkg	37	86,660	9,730	137,540	72,200	37
Total Product Wastes†	29	264,580	33,880	254,720	113,770	28
Other Wastes						
Food Wastes	2.2	47,280	0	31,520	0	0
Yard Trimmings (1)	51	193,600	31,830	21,500	5,800	17
Miscellaneous Inorganic Wastes	Neg.	4,850	0	4,850	0	0
Total Other Wastes	26	245,730	31,830	57,870	5,800	12
Total MSW Recovered (2)	28	510,310	64,670	312,590	111,320	21
Total MSW Recovered (3)	na	510,310	65,710	312,590	119,570	23

* Product recovery based on Delaware-specific information provided by the DSWA, municipalities and private recyclers.

Recovery of other products, with the exception of appliances and tires, based on revised national 1999 per capita rates.

** Appliance recovery estimated by Steel Recycling Institute.

Scrap tire recovery rate includes tires collected for energy recovery estimated by Scrap Tire Management Council for 1998.

(1) Yard Trimmings recovery does not include an estimated 141,700 tons yard trimmings diverted from landfilling through source reduction.

(2) EPA estimated recovery. Total MSW Recovered excluding tires collected for energy recovery, and that portion of major appliances considered non-recoverable.

(3) Total MSW Recovered including tires collected for energy recovery, and that portion of major appliances considered non-recoverable. Not available on the national level.

MSW does not include construction and demolition debris, industrial process wastes, or certain other wastes.

Details may not add to totals due to rounding.

Assumed that material collected at Recycle Delaware centers was from residential sources.

2000 Delaware Recycling Report. *Safeguarding Our Environment.*

Delaware Population 1999 753,538

Delaware Population 2000 783,600

Source: Franklin Associates, Ltd.

Newspaper. Nationally an estimated 54 percent of newspapers are recovered for recycling. Delaware data showed a 48 percent statewide recovery rate for newspaper. There is no indication that any substantial recovery efforts in Delaware in 2000 were unaccounted for.

Books. Nationally, books are recovered at a higher rate through the commercial sector than the residential sector. Assuming a statewide recovery of books similar to the national average (17 percent), commercial sector recovery is estimated at 70% percent of commercial generation and residential recovery at four percent of residential generation.

Magazines. It appears that Delaware is recovering magazines at a recycling rate higher than national average. Recycle Delaware recovered over 40 percent of the residential magazine generation. Commercial recovery of magazines was assumed to be similar to national average. The national average for magazine recovery was 25 percent in 1999.

Office Paper. Delaware's office paper recovery is estimated at 41 percent of generation. The office paper recovered was assumed to be entirely from the commercial sector. Recyclers reported that a large portion of the recovered office paper is from document destruction services. Recovery was estimated by applying recovery rates to estimated generation by NAICS codes. The recovery rates were developed from a telephone survey conducted by Franklin Associates.

Telephone Directories. Based on DSWA data, residential telephone directories are being recovered at a higher recycling rate than national average. Commercial recovery of telephone directories was assumed to be similar to national average.

Third Class Mail and Other Commercial Printing. Information received through the phone survey and DSWA data suggested that third class mail and other commercial printing is being recovered as a mixed paper grade. The U.S. Postal Service reported recovering mixed office paper, undeliverable third class mail and lobby waste. Since recovery is done on an individual office basis, statewide quantities of mixed paper recovered by the U.S. Postal Service are not known. Recyclers also reported recovery of a mixed paper grade. Due to the lack of complete data on third class mail and other commercial printing recovery, the average national recovery estimate was applied to Delaware generation.

Clothing and Footwear and Towels, Sheets, and Pillowcases. Commercial recyclers reported some textile recovery in 2000. National textile recovery levels were used to estimate recovery of textiles in Delaware. There is no estimate on the quantity going to reuse, export, or recycled fiber markets.

Other Miscellaneous Nondurables. DSWA collected 22 tons of batteries through the Recycle Delaware program. These batteries were collected separately for proper disposal and not recycling. Therefore this quantity is not included in the recycling rate.

CONTAINERS AND PACKAGING

Glass Packaging. Recycle Delaware glass recovery accounts for glass bottles recovered at the drop-off centers and does not include those bottles recovered through the deposit redemption system. The quantity of glass bottles recovered through the deposit redemption system is not tracked by the state or any retail/wholesale organization. Commercial establishments were contacted by telephone to estimate the percentage of deposit containers returned for redemption. These establishments included grocery stores, liquor stores, nightclubs, restaurants and taverns. Additionally, distributors and glass recyclers were contacted.

This information was combined with a survey conducted by the Center for Applied Demography & Survey Research University of Delaware (Univ. DE 1999) and Recycle Delaware data. Redemption of beer bottles appears to be easier than glass soft drink bottles; therefore, a higher redemption rate was assumed for beer bottles. Beer bottles account for over 98 percent of beverage glass generation and soda bottles for approximately 2 percent of generation. Table 10 shows the estimated redemption rate as well as the number of deposit containers generated and redeemed for a deposit.

Recovery of other glass bottles was estimated from DSWA data and information obtained from recyclers through the telephone survey. The DSWA data reported residential glass recovery by color. The tonnages of commercial glass recovered by the recyclers contacted appeared to be wine and liquor bottles. Commercial recovery of food and other bottles was assumed to be similar to national average. Total glass recovery in Delaware is higher than national average due to a higher recovery of beer and soda bottles.

Steel Packaging. A large quantity of ferrous is being recovered in Delaware (more than 417,000 tons), but commercial collection of ferrous includes mostly non-MSW ferrous such as scrap vehicles. The steel packaging quantified in this report is steel food and paint cans and other packaging such as strapping.

In 1997, the Recycle Delaware program collected approximately 7 percent of the residential steel cans. In 2000, residential steel can recovery through the Recycle Delaware program increased to over 10 percent of the residential generated steel cans. Commercial recovery of steel cans was estimated from information obtained from a telephone survey of commercial establishments. Total steel can recovery for Delaware was estimated at 11 percent, which is below national average. In 1997, steel cans were recovered through magnetic separation at a waste-to-energy facility. This MSW management option was not used in Delaware in 2000.

Aluminum Packaging. Delaware's aluminum recovery was assumed to be similar to the U.S. average. National end-users of recovered cans reported that recovery activity in Delaware was similar to other states.

Table 10
DELAWARE CONTAINER DEPOSITS PAID AND REDEEMED (2000)

	Units Generated in 2000 (1)	Dollars per Deposit (2)	Deposits Paid (dollars) (3)	Percentage of Containers Returned for Deposit (4)	Number of Containers Returned for Deposit (5)	Deposits Redeemed (dollars) (6)	Deposits Unredeemed (dollars) (7)
Soft Drink							
20 oz PET (plastic)	40,547,980	\$0.05	\$2,027,400	29.5%	11,969,760	\$598,490	\$1,428,910
Glass one-way	713,870	\$0.05	\$35,690	29.5%	210,730	\$10,540	\$25,150
Glass refill	951,830	\$0.05	\$47,590	29.5%	280,980	\$14,050	\$33,540
Beer							
Glass one-way	40,866,230	\$0.05	\$2,043,310	36.5%	14,904,730	\$745,240	\$1,298,070
Glass refill	10,216,560	\$0.05	\$510,830	79.6%	8,132,380	\$406,620	\$104,210
TOTAL	<u>93,296,470</u>		<u>\$4,664,820</u>		<u>35,498,580</u>	<u>\$1,774,940</u>	<u>\$2,889,880</u>

(1) Tables A-12 and A-15

(2) www.bottlebill.org

(3) Equals Units Generated X Dollars per Deposit

(4) **Residential** redemption based on *Recycling in Delaware: Public Actions and Perceptions*. Prepared for the Pennsylvania Resources Council by the Center for Applied Demography & Survey Research, College of Human Resources, Education and Public Policy, University of Delaware adjusted with Recycle DE data and telephone survey data. **Commercial** redemption based on telephone survey of retailers, recyclers and distributors conducted by Franklin Associates, Ltd.

Residential redemption assumes that DE residents that purchase *and* redeem deposit containers (58.5%), do not return 100% of those containers for the deposit. Based on retailer estimates, only 33.4% of deposit containers sold through home markets are redeemed. $(58.5\% \times 57.1\% = 33.4\%)$. Therefore the redemption rate of residents redeeming containers is estimated at 57.1%.

(5) Equals Units Generated X Percentage of Container Returned for Deposit

(6) Equals Dollars per Deposit X Number of Containers Returned

(7) Equals Deposits Paid - Deposits Redeemed

Details may not add due to rounding.

Source: Franklin Associates, Ltd.

Paper and Paperboard Packaging. Recycle Delaware recovered approximately 11 percent of the residential corrugated boxes (OCC). Using this data plus commercial recovery data, the estimated recovery of OCC is equal to 68 percent in Delaware, higher than national average of 65 percent. No other paper and paperboard packaging recovery efforts were identified. Delaware's total paper and paperboard packaging recovery rate of 53 percent is still higher than the national average of 51 percent even though no other recovery was identified in this category.

Plastic Packaging.

Soft Drink Bottles. Similar to glass deposit containers, Delaware's redemption rate of plastic soft drink bottles is not documented. Recycle Delaware recovery was reported as total plastic containers (PET and HDPE). In 1997, it was assumed that 20 percent of the plastic bottles recovered through Recycle Delaware was residential PET soft drink bottles. This same portion of residential PET was assumed for 2000. In addition to the residential PET recovered through Recycle Delaware centers, soft drink bottles recovered through the deposit redemption system (both residential and commercial) were estimated. Even with a deposit redemption system in place, the estimated recovery of PET soft drink bottles is below national average.

Natural HDPE Bottles and Other Containers. Residential recovery of other plastic bottles and containers was estimated from DSWA data. The DSWA data reported total plastic recovered. After subtracting 20 percent to account for PET soft drink bottles, the remaining quantity recovered was assumed 67 percent HDPE bottles and 33 percent other containers. This results in a recovery rate for HDPE bottles of 31 percent and a 4 percent recovery of other containers. No commercial recovery of HDPE bottles or other containers was identified.

Bags and Sacks and Wraps. No residential recovery of these materials was identified. Some commercial recovery of plastic wraps was documented. Recovery of plastic wraps through the commercial sector was estimated at national recovery levels of five percent.

Other Plastic Packaging. Delaware recyclers report large quantities of plastics recovery. It was determined from the phone survey that the majority of the plastic recovered is industrial scrap (pre-consumer). After eliminating the pre-consumer plastic, it appears that there are still strong post-consumer plastic packaging recovery programs in Delaware. The other plastic packaging recovery rate for Delaware was assumed at 13 percent of the commercial generation or three percent of total other plastic packaging generation.

Wood Packaging and Other Miscellaneous Packaging. The existence of wood packaging recovery programs was reported to DSWA on the annual recyclers' reports. Wood packaging recovery is mainly wood pallets. It was assumed that Delaware is recovering wood packaging at the national average.

OTHER WASTES

Recovery of other wastes, including food wastes, yard trimmings, and miscellaneous inorganic wastes, is estimated at 12 percent. Nationally, recovery in this category is estimated at 26 percent. The difference is that lower quantities of yard trimmings are estimated to be composted in Delaware. Yard trimmings composting was estimated at 17 percent. It should be noted that backyard composting and grasscycling (leaving grass clippings on the ground) is considered source reduction and not included in the recycling rate for Delaware.

BEVERAGE CONTAINER REDEMPTION

Delaware's bottle deposit redemption regulations were implemented at the wholesale level in 1982 and in 1983 at the retail level. All non-aluminum beer, ale, malt, carbonated soft drink, mineral and soda water containers less than 2 quarts are included in the regulations (CRI 2002). Estimates of the beverage containers recovered through the bottle deposit redemption system are shown in Table 10.

These estimates were derived from telephone interviews with retailers, recyclers and distributors, Recycle Delaware data, as well as a study done by the Center for Applied Demography & Survey Research at the University of Delaware. The University of Delaware study found that 58.5 percent of the residents that purchase deposit containers redeem them. This means that 41.5 percent of the residents that purchase deposit containers choose to take the containers to Recycle Delaware centers or dispose of them in the trash. The study did not estimate the percentage of deposit containers that were actually redeemed by the residents reporting this activity. In other words, it is unlikely that the 58.5 percent of the residents that redeemed containers redeem 100 percent of them. Some containers are probably going to Recycle Delaware centers and some are going into the trash.

Retailers estimated 33.4 percent of the deposit containers that are sold through residential markets are redeemed. Estimated recovery of deposit containers through commercial markets (taverns, nightclubs, etc.) by recyclers and distributors was 50 percent for non-refillable beer bottles and 95 percent for refillable beer bottles. Commercial establishments with plastic deposit containers estimated a 14 percent redemption rate. These estimates were based on verbal estimations and not developed from any internal record keeping data by the retailers, recyclers, or distributors.

Combining data from the University of Delaware study with the redemption estimate by retailers, those residents that buy and redeem deposit containers do so approximately 57 percent of the time ($58.5\% \times 57.1\% = 33.4\%$).

SELECT NON-MUNICIPAL SOLID WASTE

CONSTRUCTION AND DEMOLITION DEBRIS (C&D)

Recovery of construction and demolition debris, shown in Table 11, is based on DSWA data. Detail on the use of the recovered material is unavailable. For this analysis, the quantities recovered are assumed to be recovered for recycling. The source of building related C&D recovered (i.e., residential, nonresidential, construction, demolition or renovation) is not known. One hundred percent of the road and highway generation is assumed recovered. The total C&D recovered is estimated to be over 832,000 tons in 2000. Delaware recovered 57 percent of the C&D debris in 2000. Most states have no statewide records on the quantity of C&D debris recovered for recycling. Recovery rates outside Delaware that have been reported range from 37 percent to 77 percent (EPA 1998).

Table 11		
DELAWARE CONSTRUCTION & DEMOLITION DEBRIS RECOVERY ESTIMATES		
	Generation (tons)(1)	Recovery (tons)(1)(2)
	2000	2000
Residential		
Construction	20,500	
Renovation	12,400	
Demolition	19,500	
Total Residential	52,400	
Nonresidential		
Construction	6,200	
Renovation	65,600	
Demolition	391,600	
Total Nonresidential	463,400	
Total Building Related	515,800	158,700
Road & Highway	316,400	316,400
Total C&D	832,200	475,100
		57%
(1) Table 6.		
(2) DSWA data.		
Source: Franklin Associates, Ltd.		

USED OIL AND OIL FILTERS

DSWA data and the phone survey provided information that suggests an established infrastructure for used oil recovery. Although the oil recovered through Recycle Delaware is being re-refined for use, most of the recovered oil is being burned for fuel. Some burning of used oil for energy is occurring on-site. For this analysis, energy recovery is considered recycling. Table 12 shows the estimated recovery of used oil and used oil filters in Delaware. Recovery of used oil, based on DSWA data supplemented with industrial data, is estimated at 82 percent. Oil filters recovery is estimated at 66 percent of generation.

Table 12

DELAWARE ESTIMATED USED OIL AND OIL FILTER RECOVERY (2000)

Estimated Annual Used Oil Generation (1) (tons)	Estimated Annual Used Oil Recovery (2)	Estimated Annual Used Oil Filter Generation (1) (tons)	Estimated Annual Used Oil Filter Recovery (3) (tons)
5,930	4,880	700	460
	82%		66%

(1) Table A-26.

(2) DSWA data supplemented with industry data.

(3) DSWA data.

Source: Franklin Associates, Ltd.

CHANGES IN RECOVERY RATES

This section discusses the MSW categories that exhibited changes in recovery rates between 1997 and 2000. Table 13 shows percent recovery for both the U.S. and Delaware. The methodology for estimating recovery rates relies on private companies voluntarily reporting the quantity of materials recovered, DSWA data, and professional judgment based on information obtained through telephone interviews and past project work. This methodology is susceptible to inconsistencies from year to year. Therefore a slight change from year to year does not necessarily signify a change in the recovery system but, most likely, a change in the available data.

Durable Goods. The decrease in the recovery rate for durable goods is due to lower metals recovery. In 1997, some Delaware MSW was being processed by a waste-to-energy facility in Pennsylvania. This facility utilized magnetic separation before energy recovery on the incoming waste stream and after energy recovery on the ash. Metals from small appliances and miscellaneous durables were recovered.

Nondurable Goods. The total recovery rate for nondurable goods is only slightly lower in 2000 than 1997. A review of the individual products shows a decrease in newspaper and book recovery and an increase in magazine and telephone directories. The decrease in the book recovery rate follows the change in the U.S. recovery rate. The DSWA 1997 Recycle Delaware data separated newspapers from magazines and telephone directories. In 2000, the DSWA recovered quantities of these three grades were combined. In 2000, the allocation of the total quantity recovered to newspapers, magazines, and telephone directories was similar to the distribution of the 1997 data. It is quite possible that newspaper recovery is understated and magazine and telephone directory recovery is overstated.

Table 13
COMPARISON OF 1997 AND 2000 MSW RECOVERY RATES (1)

	U.S. Recovery		Delaware Recovery	
	1996	1999	1997	2000
	%	%	%	%
Products				
Durable Goods				
Major Appliances	81.0	84.0	88.0	84.0
Small Appliances	1.3	2.1	5.5	0.0
Furniture and Furnishings	Neg.	Neg.	0.0	0.0
Carpets and Rugs	1.3	0.8	1.3	0.8
Rubber Tires	76.0	66.0	76.0	67.9
Batteries, lead acid	94.0	96.4	94.0	95.6
Miscellaneous Durables				
Selected Consumer Electronics		9.1		0.4
Other Miscellaneous Durables		5.3		0.0
Total Miscellaneous Durables	6.2	5.8	16.0	0.0
Total Durable Goods	26.0	25.0	29.0	21.2
Nondurable Goods				
Newspapers	54.0	54.1	52.0	48.0
Books	18.0	16.8	18.0	17.2
Magazines	24.0	24.9	10.0	36.8
Office Papers	48.0	47.1	41.0	40.5
Telephone Directories	11.0	17.6	4.9	32.9
Third Class Mail	15.0	25.6	15.0	25.6
Other Commercial Printing	12.0	19.6	12.0	19.6
Tissue Paper and Towels	Neg.	Neg.	0.0	0.0
Paper Plates and Cups	Neg.	Neg.	0.0	0.0
Plastic Plates and Cups	1.2	Neg.	0.0	0.0
Trash Bags	Neg.	Neg.	0.0	0.0
Disposable Diapers	Neg.	Neg.	0.0	0.0
Other Nonpackaging Paper	Neg.	Neg.	0.0	0.0
Clothing and Footwear	13.0	13.8	13.0	13.8
Towels, Sheets and Pillowcases	17.0	17.9	17.0	17.7
Other Miscellaneous Nondurables	Neg.	Neg.	0.0	0.0
Total Nondurable Goods	23.0	25.6	22.0	23.0
Containers and Packaging				
Glass Packaging				
Beer and Soft Drink Bottles	32.0	28.3	95.0	51.8
Wine and Liquor Bottles	25.0	22.4	21.0	20.2
Food and Other Bottles & Jars	26.0	25.5	21.0	13.5
Total Glass Packaging	29.0	26.3	43.0	29.8
Steel Packaging				
Beer and Soft Drink Cans	Neg.	Neg.	0.0	
Food and Other Cans	58.0	56.8	26.0	10.8
Other Steel Packaging	29.0	70.8	29.0	71.4
Total Steel Packaging	57.0	57.9	26.0	15.9

Table 13 continued
COMPARISON OF 1997 AND 2000 MSW RECOVERY RATES (1)

	U.S. Recovery		Delaware Recovery	
	1996 %	1999 %	1997 %	2000 %
Aluminum Packaging				
Beer and Soft Drink Cans	64.0	55.6	64.0	55.7
Other Cans	Neg.	Neg.	0.0	0.0
Foil and Closures	8.3	7.9	8.3	8.2
Total Aluminum Packaging	52.0	44.9	52.0	45.4
Paper & Paperboard Pkg				
Corrugated Boxes	67.0	64.8	67.0	67.9
Beverage Cartons	Neg.	Neg.	0.0	0.0
Folding Cartons	18.0	7.1	0.0	0.0
Other Paperboard Packaging	Neg.	Neg.	0.0	0.0
Bags and Sacks	13.0	13.1	0.0	0.0
Other Paper Packaging	Neg.	Neg.	0.0	0.0
Total Paper & Board Pkg	54.0	50.9	50.0	52.8
Plastics Packaging				
Soft Drink Bottles	40.0	35.8	66.0	23.9
Natural HDPE Bottles	31.0	31.9	29.0	31.1
Other Containers	15.0	11.0	6.0	3.8
Bags and Sacks	3.7	0.6	0.0	0.0
Wraps	2.7	5.1	2.7	5.1
Other Plastics Packaging	1.3	2.6	3.0	2.6
Total Plastics Packaging	9.8	9.1	11.0	6.3
Wood Packaging	7.4	6.4	7.4	6.4
Other Misc. Packaging	Neg.	Neg.	0.0	0.0
Total Containers & Pkg	40.0	36.7	39.0	36.5
Total Product Wastes†	29.0	28.7	31.0	28.4
Other Wastes				
Food Wastes	2.4	2.2	0.0	0.0
Yard Trimmings	39.0	51.1	8.7	17.5
Miscellaneous Inorganic Wastes	Neg.	Neg.	0.0	0.0
Total Other Wastes	21	26	5	12
Total MSW Recovered (2)	27	28	22	21
Total MSW Recovered (3)	na	na	24	23

(1) From Table 9 and *Assessment of Solid Waste Discards in Delaware and The Potential for Recycling of Materials*. DSWA. April 1999.

(2) EPA estimated recovery. Total MSW Recovered excluding tires collected for energy recovery, and that portion of major appliances considered non-recoverable.

(3) Total MSW Recovered including tires collected for energy recovery, and that portion of major appliances considered non-recoverable. Not available on the national level.

Source: Franklin Associates, Ltd.

Containers and Packaging. There are three reasons for the changes in containers and packaging. In 2000, recovery through the deposit redemption system was research further than had been done in 1997. In 1997, national deposit redemption recovery rates were assumed for plastic and glass deposit redemption containers. A telephone survey was conducted prior to estimating the 2000 recovery levels. This survey indicated that recovery estimates of glass and plastic containers through the deposit redemption system were lower than previous estimates.

The aluminum can recovery rate, lower in 2000, follows the national recovery rate. The third reason for lower recovery of containers and packaging is that the steel cans that had previously been recovered through magnetic separation at the waste-to-energy facility are no longer being recovered.

Other Wastes. Yard trimmings recovery increased substantially. This is probably due to both an increased effort on the part of municipalities to provide more service and improved record keeping.

CHAPTER 3 SOLID WASTE DISCARDS

MSW DISCARDS

MSW discards include the solid wastes remaining after recycling and composting. Table 14 shows Delaware's MSW generation, recovery, and discards. Total MSW discards for Delaware are estimated at over 637,000 tons. Durable goods and nondurable goods equal approximately 22.5 percent and 21.5 percent of the total discards respectively. Approximately 37,000 tons (5.8 percent) of the discards are estimated to be newspapers, magazines, and office papers. Mixed papers (third class mail and other commercial printing) are an additional 25,860 tons. Total containers and packaging is 22.3 percent of total MSW discards. Food waste (12 percent of discards) and yard trimmings (28 percent of discards) are the two individual components contributing the most to total discards.

Total MSW discards estimated by this study are lower than the tonnages recorded by Delaware's MSW landfills. However, significant quantities of non-MSW discards are disposed of in Delaware's MSW landfills. Internal Franklin Associates data suggests that, typically, one-fourth to one-third of the waste received at MSW landfills is non-MSW. The non-MSW waste streams may include the following:

- Construction and demolition debris
- Agricultural waste
- Land clearing debris
- Street sweepings
- Automotive and equipment repair parts
- Combustion ash
- Industrial process wastes.

Except for construction and demolition debris, none of these waste streams are included in this report. In addition, non-MSW discarded in MSW landfills due to severe weather conditions, such as floods, ice storms, etc., is not accounted for in this study.

Delaware's residential MSW discards are estimated at 444,600 tons (Table 9; 510,310 tons generation minus 65,710 tons recycled/composted). On a per capita basis this equals 3.12 pounds per person per day or .57 tons per person per year.

Delaware's commercial MSW discards are estimated at 193,030 tons (Table 9; 312,600 minus 119,570). On a per capita basis this equals 1.35 pounds per person per day or 0.25 tons per person per year.

Table 14
DELAWARE MUNICIPAL SOLID WASTE DISCARDS

	Generation (1)		Recovery (2)		Discards (3)	
	2000		2000		2000	
	(tons/yr)	%	(tons/yr)		(tons/yr)	%
Products						
Durable Goods						
Major Appliances	11,500	1.4	9,660		1,840	0.3
Small Appliances	2,700	0.3	0		2,700	0.4
Furniture and Furnishings	25,000	3.0	0		25,000	3.9
Carpets and Rugs	7,100	0.9	60		7,040	1.1
Rubber Tires	14,000	1.7	9,500		4,500	0.7
Batteries, lead acid	5,900	0.7	5,640		260	0.0
Miscellaneous Durables						
Selected Consumer Electronics	5,100	0.6	20		5,080	0.8
Other Miscellaneous Durables	46,000	5.6	0		46,000	7.2
Total Miscellaneous Durables	51,100	6.2	20		51,080	8.0
Total Durable Goods	117,300	14.3	24,880		92,420	14.5
Nondurable Goods						
Newspapers	33,100	4.0	15,890		17,210	2.7
Books	3,200	0.4	550		2,650	0.4
Magazines	7,400	0.9	2,720		4,680	0.7
Office Papers	25,400	3.1	10,290		15,110	2.4
Telephone Directories	2,100	0.3	690		1,410	0.2
Third Class Mail	15,300	1.9	3,920		11,380	1.8
Other Commercial Printing	18,000	2.2	3,520		14,480	2.3
Tissue Paper and Towels	9,300	1.1	0		9,300	1.5
Paper Plates and Cups	2,700	0.3	0		2,700	0.4
Plastic Plates and Cups	2,600	0.3	0		2,600	0.4
Trash Bags	2,700	0.3	0		2,700	0.4
Disposable Diapers	9,000	1.1	0		9,000	1.4
Other Nonpackaging Paper	13,300	1.6	0		13,300	2.1
Clothing and Footwear	20,800	2.5	2,870		17,930	2.8
Towels, Sheets and Pillowcases	2,200	0.3	390		1,810	0.3
Other Miscellaneous Nondurables	10,700	1.3	0		10,700	1.7
Total Nondurable Goods	177,800	21.6	40,840		136,960	21.5
Containers and Packaging						
Glass Packaging						
Beer and Soft Drink Bottles	10,300	1.3	5,340		4,960	0.8
Wine and Liquor Bottles	5,200	0.6	1,050		4,150	0.7
Food and Other Bottles & Jars	10,800	1.3	1,460		9,340	1.5
Total Glass Packaging	26,300	3.2	7,850		18,450	2.9
Steel Packaging						
Beer and Soft Drink Cans	Neg.	Neg.	0		0	0
Food and Other Cans	7,600	0.9	820		6,780	1.1
Other Steel Packaging	700	0.1	500		200	0.0
Total Steel Packaging	8,300	1.0	1,320		6,980	1.1

Table 14 continued
DELAWARE MUNICIPAL SOLID WASTE DISCARDS

	Generation (1)		Recovery (2)		Discards (3)	
	2000		2000		2000	
	(tons/yr)	%	(tons/yr)		(tons/yr)	%
Aluminum Packaging						
Beer and Soft Drink Cans	4,400	0.5	2,450		1,950	0.3
Other Cans	100	0.01	0		100	0.02
Foil and Closures	1,100	0.1	90		1,010	0.2
Total Aluminum Packaging	5,600	0.7	2,540		3,060	0.5
Paper & Paperboard Pkg						
Corrugated Boxes	98,000	12	66,580		31,420	4.9
Beverage Cartons	2,100	0.3	0		2,100	0.3
Folding Cartons	15,600	1.9	0		15,600	2.4
Other Paperboard Packaging	700	0.1	0		700	0.1
Bags and Sacks	4,700	0.6	0		4,700	0.7
Other Paper Packaging	4,900	0.6	0		4,900	0.8
Total Paper & Board Pkg	126,000	15	66,580		59,420	9.3
Plastics Packaging						
Soft Drink Bottles	2,300	0.3	550		1,750	0.3
Natural HDPE Bottles	1,900	0.2	590		1,310	0.2
Other Containers	7,600	0.9	290		7,310	1.1
Bags and Sacks	4,900	0.6	0		4,900	0.8
Wraps	7,300	0.9	370		6,930	1.1
Other Plastics Packaging	7,700	0.9	200		7,500	1.2
Total Plastics Packaging	31,700	3.9	2,000		29,700	4.7
Wood Packaging	25,600	3.1	1,640		23,960	3.8
Other Misc. Packaging	700	0.1	0		700	0.1
Total Containers & Pkg	224,200	27.2	81,930		142,270	22.3
Total Product Wastes	519,300	63.1	147,650		371,650	58.3
Other Wastes						
Food Wastes	78,800	9.6	0		78,800	12
Yard Trimmings	215,100	26	37,630		177,470	28
Miscellaneous Inorganic Wastes	9,700	1.2	0		9,700	1.5
Total Other Wastes	303,600	37	37,630		265,970	42
Total MSW Discarded	822,900	100	185,280		637,620	100

(1) Table 1.

(2) Table 9.

(3) Discards = generation minus recovery.

Details may not add to totals due to rounding.

Neg. = negligible

Source: Franklin Associates, Ltd.

Even though residential MSW generation is an estimated 62 percent of total MSW generation (Table 2), residential MSW discards represent an estimated 70 percent of total MSW discards. This is due to a higher recovery rate in the commercial sector.

MSW DIVERSION FROM DISPOSAL

The quantity of yard trimmings diverted from disposal by on-site management in Delaware was estimated for the first time in 2000. The U.S. EPA considers yard trimmings that are managed on-site by homeowners as source reduction. Since source reduction occurs before generation of MSW, the estimates shown in this section are not included in the generation or recovery estimates shown in Chapters 1 and 2. Only those yard trimmings collected for off-site management are included as part of MSW generation and recovery.

A combination of data sources was used to estimate Delaware's source reduction of yard trimmings. Delaware specific weight and area data from grass clippings that were collected, over a growing season, were combined with three additional sources of information. These three sources included (1) surveys sent to Delaware residents (2) Kent county residential lot size information based on geographic information systems (GIS) data and (3) Delaware census data on housing and population.

Table 15 shows an estimated 141,700 tons of residential yard trimmings diverted from disposal by source reduction. Adding this estimated source reduction (141,700 tons) to the total quantity of yard trimmings recovered (37,630 tons) results in an estimated diversion from disposal of 179,330 tons in 2000. This represents a 50 percent diversion of the potential generation of yard trimmings.

Diversion including source reduction of yard trimmings as a percentage of total potential MSW generation is equal to 34 percent. This compares to the 23 percent total recovery shown in Table 9.

C&D DEBRIS DISCARDS

As mentioned above, C&D debris generated from residential and commercial projects is not estimated as part of MSW although it is often discarded in MSW landfills. Delaware's estimated C&D discards are 357,100 tons in 2000 (Table 11; 832,200 minus 475,100). The amount of C&D being discarded in permitted or non-permitted C&D landfills is unknown. Two permitted C&D landfills in Delaware were contacted for this report but both refused to participate.

Table 15
Delaware Estimated Yard Trimmings Diversion in 2000

	Yard Trimmings					Diversion as % of Potential Generation
	Actual Generation (1) (tons/yr)	Potential Generation (2) (tons/yr)	Recovery for Recycling (3) (tons/yr)	Source Reduction (4) (tons/yr)	Total Diversion (tons/yr)	
Residential Sector	193,600	335,300	31,830	141,700	173,530	52%
Non-residential Sector	<u>21,500</u>	<u>21,500</u>	<u>5,800</u>	<u> </u>	<u>5,800</u>	<u>27%</u>
Totals	215,100	356,800	37,630	141,700	179,330	50%
	Total MSW					Diversion as % of Potential Generation
	Actual Generation (1) (tons/yr)	Potential Generation (2) (tons/yr)	Recovery for Recycling (3) (tons/yr)	Source Reduction (4) (tons/yr)	Total Diversion (tons/yr)	
Residential Sector	510,310	652,010	65,710	141,700	207,410	32%
Non-residential Sector	<u>312,590</u>	<u>312,590</u>	<u>119,570</u>	<u> </u>	<u>119,570</u>	<u>38%</u>
Totals	822,900	964,600	185,280	141,700	326,980	34%

(1) Table 2.

(2) Includes estimated MSW generation plus yard trimmings estimated as managed on-site (source reduction).

(3) Table 9.

(4) Franklin Associates, Ltd estimate based on 2002 Delaware survey.

Source: Franklin Associates, Ltd.

CHAPTER 4

RESIDENTIAL YARD TRIMMINGS SURVEY

An anonymous residential survey instrument was developed for the main purpose of gathering information to be used to estimate statewide source reduction quantities of yard trimmings⁶. Grasscycling, the management practice of leaving grass clippings on the lawn instead of bagging for disposal, is the major source of the reduction. Residents were asked to provide information about grass, leaves, and plant trimmings and brush management practices. Residents were also asked about their awareness of Delaware Solid Waste Authority's (DSWA) consumer electronics and household hazardous waste collection programs.

The survey was first sent to the DSWA staff for review. After making changes based on staff comments, surveys were sent to 1,700 residents. The surveys differed slightly from county to county so responses could be tracked by county. DSWA provided the computer generated randomly selected address labels. The allocation of the mailing labels, by county, was as follows: New Castle 76 percent, Kent 12 percent, and Sussex 12 percent. Table 16 shows the response rate by county.

Table 16 Delaware Residential Yard Trimmings Survey, 2002				
County	Surveys Mailed	Surveys Returned Undeliverable	Survey Responses	Responses as a Percent of Delivered Surveys
Kent	214	25	62	33%
New Castle	1,286	93	244	20%
Sussex	200	35	48	29%
Total	1,700	153	354	23%

Franklin Associates, Ltd.

⁶ Estimated source reduction of yard trimmings is shown in Table 14.

SURVEY QUESTIONS AND RESPONSES

The following discussions addresses each question as it appeared on the survey. An example of the survey and county specific details are included in the appendices to this report.

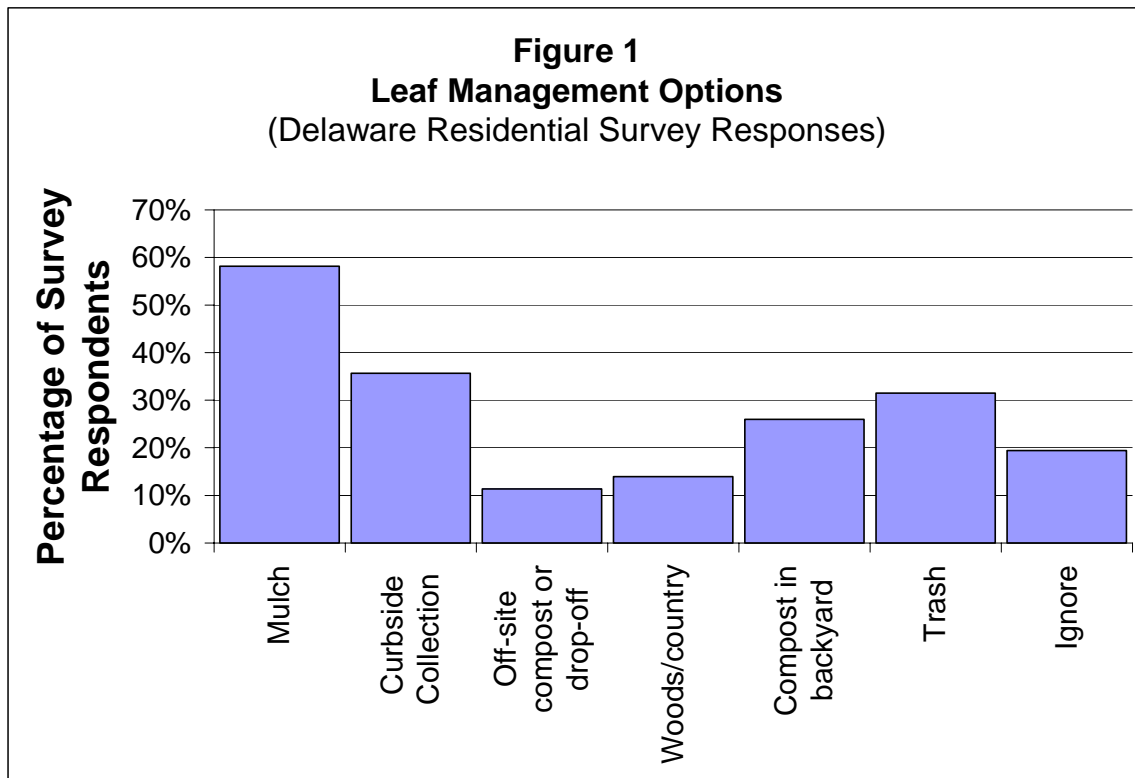
In what type of residence do you live? Since the target group was single-family residents, this question was asked to verify that the responses were from the correct population base. Single-family residents are those housing units with four or less units per structure. Eighty-three percent of those responding to the survey lived in one-unit structures. Eight percent lived in a two to four housing unit structure and the remaining nine percent lived in multi-family (five or more units per structure) housing.

Are you responsible for your yard waste management? This question was designed to eliminate those respondents in multi-family housing, those with no yard to manage and those who aren't responsible for their yard waste management. These respondents were directed to skip the yard waste management questions. Seventy-seven percent of the respondents manage their own yard waste. Twelve percent hire a lawn service company. The remaining eleven percent either had no yard to manage or a landlord or community association provides maintenance.

What are your management practices? The survey questionnaire separated this management question into three types of yard waste: leaves, grass clippings, and plant trimmings and brush. The respondents were asked to estimate the percentage of their yard waste they managed with each option. For example, a respondent may use grasscycling, composting and trash collection for grass clippings. Most respondents used more than one management option.

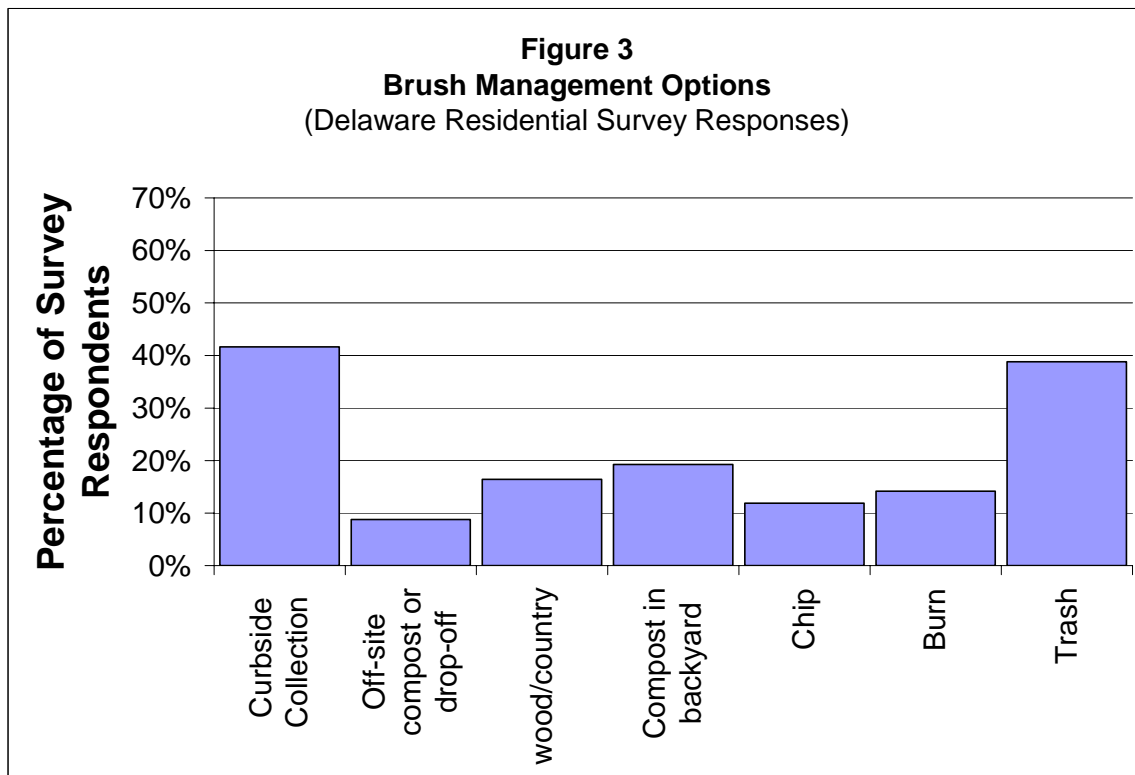
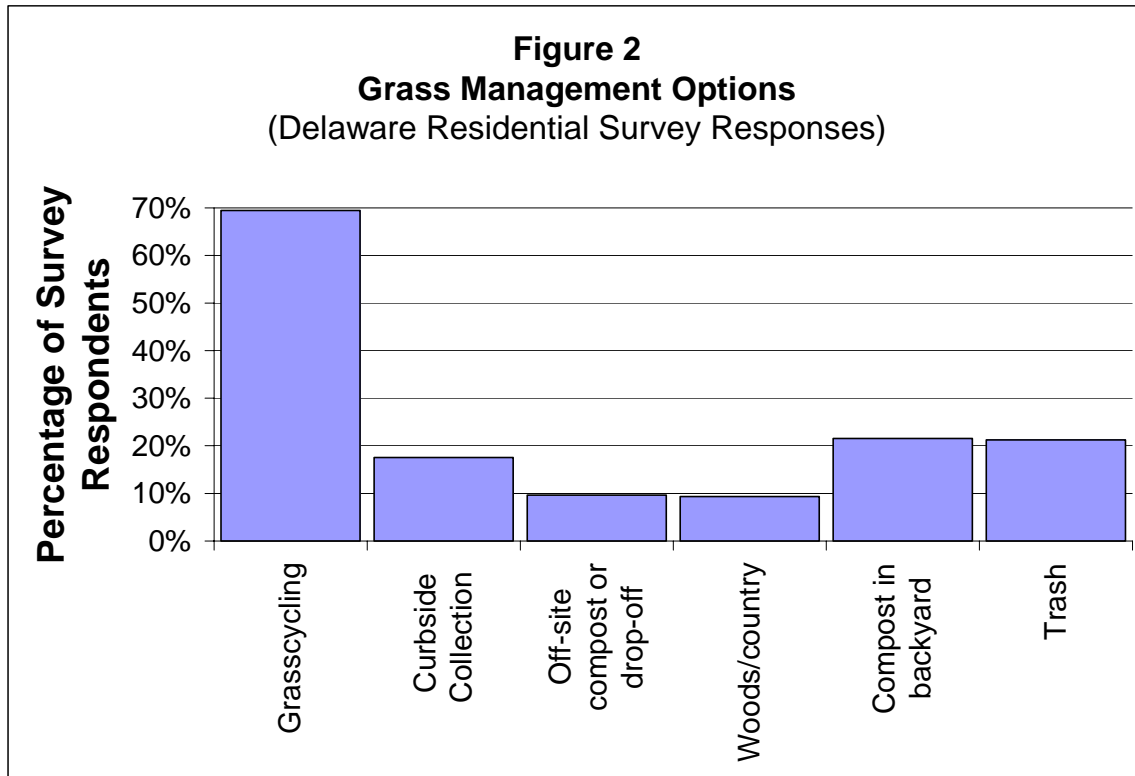
It was apparent that some respondents thought that the curbside collection management option was the same as the trash collection option and thus checked both options on the survey. Franklin Associates made no attempt to adjust the surveys so that they reflect the respondents' true intent. Therefore, no conclusions can be drawn regarding curbside collection of yard trimmings for composting separately from curbside collection for disposal.

I do the following with the leaves in my yard. Figure 1 shows the percentage of respondents that use each leaf management option. Mulching is the most popular method. Of those residents that mulch, 40 percent mulch 50 percent or more of their leaves and 60 percent use the mulching option less than 50 percent of the time.



I do the following with the grass clippings in my yard. Figure 2 shows the percentage of respondents that use each grass management option. Grasscycling is the most popular method (68 percent). Of those residents that grasscycle, approximately 75 percent grasscycle 50 percent or more of their leaves and 25 percent use the grasscycling option less than 50 percent of the time. It should be noted that although 68 percent of the survey respondents participated in grasscycling, this differs from the 75 percent participation rate estimated on a statewide bases. The survey results suggested that the larger the lot size the more likely the homeowner is to grasscycle. Since a higher proportion of survey respondents resided on smaller lots, the lower participation rate by the survey respondents reflects this. In other words, the higher statewide participation rate reflects a different distribution of lot sizes.

I do the following with the plant trimmings and brush in my yard. Figure 3 shows the percentage of respondents that use each brush management option. Curbside collection either through a separate collection or combined with the trash collection is the most popular method of brush management. Approximately 40 percent was reported for both options.



How many years have you been leaving grass clippings on the lawn? A high percentage of respondents leave grass clippings on the lawn (grasscycle). Of those that grasscycle, two-thirds have done so for more than five years. Thirty percent have grasscycled more than one year but less than five. The remaining three percent have grasscycled for less than one year.

Why do you leave the grass clippings on the lawn? The most common reason was that grasscycling is good for the lawn. Forty-one percent provided this answer, while 34 percent grasscycled for convenience. Saving landfill space was the motivation for 11 percent of the respondents, 7 percent leave the grass clippings on the lawn to save money and 5 percent site the lack of a curbside collection or drop-off site as the reason for grasscycling. Two percent sited other reasons such as physically not being able to rake and bag grass clippings.

If you don't leave grass clippings on the lawn, please indicate your reason. When asked the reason for not grasscycling, the most common answer, at 57 percent, was "I don't like the way it looks". Nineteen percent responded that they enjoyed the activity of bagging the grass and 14 percent believe it hurts the grass to leave the clippings on the lawn. Ten percent listed other reasons such as grass being tracked into the house by pets and kids and not having a mulching mower.

How many years have you been backyard composting? Thirty-one percent of those responding composted their yard trimmings, while 69 percent did not. Of those that backyard compost, 70 percent have been composting for more than five years. Nine percent have been composting for four years, 16 percent for one to three years and four percent for less than one year.

Why do you backyard compost? Fifty-three percent feel that composting is good for the soil. Saving landfill space is the main motivation for 20 percent of the composters. Eleven percent feels that it saves money and seven percent site the lack of a city/county composting program as their reason for backyard composting. The other nine percent listed reasons such as easier than bagging, enjoy the activity, and a need for compost in their gardens.

If you don't backyard compost, how likely are you to start? Only two percent of the non-composters responded that they were very likely to start composting and 12 percent felt that they were likely to start. Sixty-three percent felt that they were not likely to start composting and the remaining 23 percent stated that they would not be interested in backyard composting.

If you don't backyard compost, please indicate your reason. The survey listed six choices plus an "other" option for non-composters to give as their reason for not composting. Nineteen percent responded that they did not have the space and 18 percent stated that they did not have the time. Sixteen percent do not want a bin in their backyard and 15 percent felt that there would be an odor from the compost bin. Fourteen percent

felt it would be too much trouble and another 14 percent did not know how to compost. The remaining four percent listed reasons such as too old, against home association rules, not physically able and spouse doesn't want a compost bin in the backyard.

What is the size of your yard? Respondents were given two options for estimating this information (1) the size of yard only or (2) the size of the lot including the structure(s). For both options, approximately 80 percent of the survey respondents resided on less than one-half acre. The larger the lot the higher the percentage of respondents that grasscycle. Seventy percent of those respondents with less than one-fourth acre grasscycle. This increases to 74 percent for those respondents with a lot one-fourth acre but less than one-half acre. Ninety percent of those responding with a lot size of one-half acre or more grasscycle.

What has been your observation of the yard waste management provided by your landlord or community association? The survey respondents that were not responsible for yard trimmings management were asked their observations on the management provided by their landlord or community association. Forty-eight percent did not know what yard trimmings management option was used at their residence. Twenty-one percent thought grass clippings were left on the lawn and 17 percent thought all yard trimmings were placed in with the trash. Fourteen percent thought all of the yard trimmings were removed from the site.

Are you aware of the consumer electronic collection events sponsored by the Delaware Solid Waste Authority? This question was added to the survey to judge the public awareness of the new consumer electronics drop-off service provided by the Authority. Seventeen percent of the respondents said yes, they are aware of the consumer electronics collection program.

Do you have any consumer electronics stored on your property that you no longer use? How Many? Of the 17 percent with knowledge of the collection program, 57 percent reported having an old TV and 77 percent reported having an old computer monitor that needed to be managed. Additionally, 68 percent have other computer components, 44 percent have old stereo equipment and 5 percent listed other consumer electronics they wanted to dispose of. The other products listed included VCRs, telephones, and copiers.

Are you aware of the household hazardous collection events sponsored by the Delaware Solid Waste Authority? This question was added to the survey to judge the public awareness of the household hazardous collection events sponsored by the Authority. Thirty-six percent of the survey respondents stated that they were aware of the collection program. Several respondents commented that the household hazardous collection events were too infrequent. Other respondents felt that the Authority needed to publicize the collection events more.

REFERENCES

Beer Institute. 2001 Brewers Almanac.

Beverage Marketing Corporation of New York. *Wine and Spirits in the U.S.* September 2000.

Beverage World. Annual Market Index. May 2000.

Beverage World. CSD Packaging 2000. June 2001.

Container Recycling Institute. www.bottlebill.org/usa/states. 2002.

Delaware Department of Natural Resources and Environmental Control (www.dnrec.state.de.us).

Delaware Department of Natural Resources and Environmental Control (www.dnrec.state.de.us). *Air and Waste Management: The Homeowners Guide to Open Burning*.

Delaware Department of Transportation (DelDOT). *Delaware Transportation Facts 2001*.

Delaware Office of State Planning Coordination. *Gross Land Use Changes in Delaware 1992 to 1997*. August, 1999.

Delaware Office of State Planning Coordination. *Absorption Analysis. Of the Strategies for State Policies and Spending*. www.state.de.us/planning. 2002.

Delaware Solid Waste Authority. *Safeguarding Our Environment*. 2001.

Delaware Solid Waste Authority. *Assessment of Solid Waste Discards in Delaware and the Potential for Recycling of Materials*. Franklin Associates, Ltd. April 1999.

Delaware State Housing Authority. *Housing Production in Delaware* (Doc. #10-03-98-04-01). 1997.

Delaware State Housing Authority. *Housing Production in Delaware* (Doc. #10-03-00-05-01). 1999.

Delaware State Housing Authority. *Housing Production in Delaware* (Doc. #10-03-01-08-01). 2000.

“Delaware Women – Where are they Working?” Office of Occupational & Labor Market Information. http://www.oolmi.net/lib/oolmi_pub-women.asp. Downloaded 4/25/2002.

References

Editor & Publisher. *International Year Book*. 2001. The Editor & Publisher Company. New York, NY. 212.675.4380.

F.W. Dodge Division. The McGraw Hill Companies. *Dodge Local Construction Potentials Bulletin*, State of Delaware. December 2000.

Franklin Associates, Ltd. Internal revised 1999 U.S. MSW characterization data worksheets. December, 2001.

Franklin Associates, Ltd. Internal document on used oil generation and recovery for the USEPA. 1994.

Franklin Associates, Ltd. *Solid Waste Management At The Crossroads*. December 1997.

Kneass, Don. "How to Start a Bottle Recycling Program". *Waste Age*. July 2001.

Keep America Beautiful, Inc. *The Role Of Recycling In Integrated Solid Waste Management To The Year 2000*. Franklin Associates. September 1994.

Kent County Comprehensive Plan Update Web Page (www.smartmap.com/kent_co/). Interactive maps. 2002.

Kent County Department of Inspections & Enforcement. Permits Issued Report. 1996. Modern Plastics. *Resins Report*. January 1998.

Kent County Department of Planning Services, Division of Planning website (www.co.kent.de.us/PlanWeb/Planning_Division/index.htm). 2002.

National Petroleum News. *Market Facts 2001*. July 2001.

New Castle County Department of Land Use, Division of Development and Licensing. December Report 2001.

Raymond Communications Inc. *State Recycling Laws Update Year-End Edition 2001*. September 2001.

Scrap Tire Management Council. *Scrap Tire Use/Disposal Study*. www.rma.org/scrap tires/disposal_study.html. 2002.

Spivey, David. *Recycling Makes for Eco-Friendly Highways*. Asphalt Paving Association of Washington. 2000.

SRDS Circulation 2001. *The Annual Comprehensive Analysis of Penetration and Circulation of Major Print Media*. SRDS. Des Plaines, IL. 847.375.5000.

Steel Recycling Institute. Fact Sheet. www.recycle-steel.org/fact/main.html.

References

University of Delaware, Center for Historic Architecture and Design. *Projected Population Growth and the New Arithmetic of Development in Delaware: 1990 to 2020*. The Office of State Planning Coordination, State of Delaware. 1999.

University of Delaware, Center for Applied Demography & Survey Research. *Recycling in Delaware: Public Actions and Perceptions*. Pennsylvania Resources Council. 1999.

U.S. Bureau of the Census. Department of Commerce. Statistical Abstracts. Various years.

U.S. Bureau of the Census. Department of Commerce. County Business Patterns, 1995 - 1999.

U.S. Bureau of the Census. Department of Commerce. Government Employees. www.census.gov/govs.

U.S. Bureau of the Census. Department of Commerce. Population statistics. Various years.

U.S. Bureau of Census. *American Housing Survey for the United States: 1999*. Table 2-3.

U.S. Department of Agriculture. Dairy Division. *Packaged Fluid Milk Sales in Federal Milk Order Markets: By Size and Type of Container and Circulation Method During November 1999*. Washington D.C. 202.720.4392.

U.S. Department of Commerce. *Profiles of General Demographic Characteristics, 2000 Census of Population and Housing, Delaware*. May, 2001.

U.S. EPA. *Measuring Recycling A Guide for State and Local Governments*. EPA530-R-97-011. September 1997.

U.S. EPA. *Characterization of Building-Related Construction and Demolition Debris in the United States*. Franklin Associates, Ltd. June, 1998.

U.S. EPA. *Characterization Of Municipal Solid Waste In The United States 1998 Update*. Franklin Associates, Ltd. August 1999.

U.S. EPA. *Municipal Solid Waste in The United States: 1999 Facts and Figures*. 530-R-01-014. Franklin Associates, Ltd. July 2001.

U.S. Federal Highway Administration. *Annual Highway Statistics*. October 2001.

Ward's Motor Vehicle Facts and Figures. 1999.